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ABSTRACT

This document is an instructional module package prepared in objective form for use by an instructor familiar with preventive maintenance methods and procedures in a water or wastewater treatment system. Included are objectives, instructor guides, and student handouts. This module includes concepts of preventive maintenance, setting up a record system, use of tools and instruments, and use of operation and maintenance manuals. (Author/RH)

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PREVENTIVE MAINTENANCE

Training Module 3.320.2.77

Prepared for the

Iowa Department of Environmental Quality
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Des Moines, Iowa 50319

by

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September, 1977

SE 024 139

The mention of trade names, or use of manufacturers technical bulletins, diagrams depicting specific equipment, or the commercial product in this module is for illustration purposes, and does not constitute endorsement or recommendation for use by Kirkwood Community College nor by the Iowa Department of Environmental Quality.

Module No:	Module Title: Preventive Maintenance
Approx. Time: 19	Submodule Title: 1. Introduction 2. Records and Schedules 3. Implementation a. PM on Sample Equipment b. O & M Manuals 4. PM Equipment

Overall Objective:

Upon completion of this module the learner should be able to use preventive maintenance records, operational and maintenance manuals and general tools and instruments for the performing of preventive maintenance.

Instructional Aids:

Handout
AV - Overhead transparancy

Instructional Approach:

Discussion
Demonstration
Exercise

References:

1. Maintenance Management Systems for Municipal Wastewater Facilities EPA-430-9-74-004
2. MOP 11 - WPCF
3. Manual of Instruction for Water Treatment Plant Operators, N. Y. Dept. of Health

Class Assignments:

Study handouts
Read the parts of text covered in class

Module No:	Topic: SUMMARY –

Instructor Notes:	Instructor Outline:
1. The diagrams, charts and figures are to be used as handouts and overhead transparencies.	I. Introduction A. What is PM B. The PM program C. Operators responsibilities D. Types of equipment used in a PM program
2. "Hands-on" use of PM equipment and application of PM upon specific equipment if available.	II. PM Record Supplies A. Importance B. Record system C. Application
3. The learner should either bring their own O & M manual or the instructor could show a sample O & M manual.	III. Instrumentation and tools used to perform PM
4. The evaluation is in 2 parts. a. Written b. Performance evaluation	IV. PM on sample equipment V. O & M manuals VI. Evaluation

Module No:	Module Title: Preventive Maintenance
	Submodule Title: Introduction
Approx. Time: 2 hours	Topic: Concepts of Preventive Maintenance

Objectives:

Upon completion of this submodule, the learner should be able to:

1. Define "preventive maintenance".
2. Identify the basic components of a PM program in a water or wastewater system.
3. Describe the operators responsibilities in a PM program.
4. Define the different types of PM within a water or wastewater facility.

Instructional Aids:

Handouts

Instructional Approach:

Discussion

References:

Personal notes

Class Assignments:

Study completed note guide

Module No:	Topic:- Introduction

Instructor Notes:	Instructor Outline:
1. Stress the importance of PM	A. What is PM? 1. Protecting an investment. 2. Avoidance of costly breakdowns 3. Keeping costs down by "watch dogging" equipment and inventory. 4. Keeping your facility in peak operational condition.
2. Hand out note guide and explain.	B. The PM program 1. Organize time and materials a. PM records b. Inventory c. Man hours
	C. Operators responsibility 1. Continuous observation of equipment and records. a. Must be able to: Detect problems and remedy them. Operate maintenance equipment Use records and manuals Work with other staff Keep costs to a minimum
4. Instructor must follow the heading in the note guide so that the learner can effectively take notes.	D. Types of equipment covered in a PM program 1. Mechanical 2. Electrical 3. Building and grounds 4. Safety equipment

NOTE GUIDE

A. What is PM?

B. The PM Program:

C. The Operators Responsibility:

D. Types of Equipment covered in a PM program:

Module No:	Module Title: Preventive Maintenance
	Submodule Title: Records and Schedules
Approx. Time: 3 hours	Topic: Starting a PM record system

Objectives:

Upon completion ot this submodule the learner should be able to:

1. Define the component stages of a PM records system.
2. Explain the importance of PM records in relation to systems evaluation and cost effectiveness.

Instructional Aids:

Handouts
Overhead transparancies
Text: "Maint. Management for Municipal Wastewater Facilities".

Instructional Approach:

Discussion
Demonstration with overhead transparancies

References:

Maintenance Management Systems for Municipal Wastewater Facilities, EPA-430/9-74-004.

MOP 11 WPCF

Manual of Instruction for Water Treatment Plant Operators, N. Y. Dept. of Health

Class Assignments:

Study handouts
Read the parts of text covered in class

Module No:	Topic: PM Equipment (Records and Schedules)

Instructor Notes:	Instructor Outline:
1. Provide sample handouts #1, 2, 3, 4 and overhead transparancies for each item in "B". 2. Divide class into groups of 3 or 4 persons for Part C. Each group will work with a specific piece of equipment.	A. Importance of records for a PM program 1. Indicate trends in equipment efficiency 2. Show cost effectiveness of maintenance program. B. Records system - Define and demonstrate each of the following: 1. Plant log 2. Equipment catalog 3. Maintenance record: ID card - service record 4. Inventory cards C. Application 1. Have learners prepare record systems or equipment that is on hand. D. Review 1. Questions and answers on Part C 2. Discuss application of record systems to water and wastewater facilities of various sizes and types.

HANDOUT #1

Typical Daily Treatment Plant Log Entry

Small Activated Sludge Plant

Thursday, August 4, 1977

D. Clampe, Superintendent. F. Smykes, Operator-Chemist. L. Jerkins, Maintenance.

7:00 a.m. Collected flow data, plant checkout, found skimmer trough clogged with grease and floating solids. Pump #1 in lift station warm and not pumping. Chlorinator injector line clogged. Turned Pump #1 off. Reviewed log entry for Wednesday.

7:15 a.m. Cleared skimmer trough and chlorine line cleaned bar screen and grit chamber.

8:30 a.m. Pump #1 clogged with bed sheet. Pump was pulled, impeller cleared and reinstalled. Put #1 back in service.

10:00 a.m. Smykes completed daily sampling and began analysis. Jerkins completed daily lubrication and clean up routine. Coffee break.

11:30 a.m. Received seal for effluent pump #2. Invoice #5086 from McFern Manufacturing Co.

1:45 p.m. Reviewed lab data. Sent Smykes to adjust air up 5 cfm and begin wasting solids to the digester.

2:30 p.m. Assisted by Jerkins effluent pump #2 was reassembled and put back into service. 1200 gal. of sludge wasted to digester.

2:45 p.m. Heavy rain began. Visited by Mayor concerning odor complaint Explained that recent high flows have caused excessive hydraulic loadings which have washed solids to the polishing ponds causing putrification in lagoon. Stressed necessity to step up I/I study.

3:15 p.m. Found chlorine injection line clogged again. Automatic valve partly open. Will repair tomorrow.

3:30 p.m. Notified Smykes to begin monthly industrial monitoring progra on Monday, August 8.

4:00 p.m. Final plant checkout completed. Rained 2.5" and still fallin Flow increasing rapidly. Agreed that Jerkins would work an extra shift. If trouble occurred to contact me at home. Bar screen and grit chamber cleaned again to prevent problems through the night.

D. Clempe, Superintendent

HANDOUT #2

Equipment Catalog: Small Iron Filtration Plant

10. North well
    11. Well pump
    12. Head gauge
    13. Check valve
    14. Force main
    15. Automatic controls
    16. Building
10. South well
    21. Well pump
    22. Head gauge
    23. Check valve
    24. Fence main
    25. Automatic controls
    26. Building
30. Elevated storage tank
    31. Altitude valve
    32. Altitude - Pressure gauge
    33. Catlodic protection
40. Pressure iron filters
    41. Filter closest to entrance
    42. Middle filter
    43. Furthest filter
    44. Force main

50. Chlorination equipment
    51. Chlorine cylinders
    52. Regulator
    53. Rotameter
    54. Feed line
    55. High pressure pump
    56. Injectors
    57. Injector lines

HANDOUT #3

Equipment I.D. Card

Equipment	Electrical
Name: Turbine pump	Name: Pump motor
Serial No: 2033568	Serial No: D 266 SAI
Model: 42 G	Model: 334
Size: 6 inch	Man: Ampashuck Corp.
No. Bowls: 6	Voltage: 220 amps 9.8 RPM 1760
Rate: 250 GPM	Phase 3 Frame F-1 H.P. 10
Head: 134 ft.	

Lubrication	Maintenance	
	Work to be Done	Frequency
Motor bearings: Slimyslick #40 or equivalent	Check seal lube	1/day
	Check for vibrations	1/day
Seal: Grimngock A14 or equivalent	Check running amperage	1/week
	Lube motor bearings	1/6 months
	Pull pump and inspect	1/yr.

HANDOUT #4 Cat. No. 11

Service Record

Date	Work Done	Initials
2-1-71	Pump pulled for inspection	
	Seal replaced	
	Shaft aligned	D. S.
2-4-71	Motor rewound	
	Bearings lubed	D. S.
2-10-71	Motor bearings lubed	D. S.

HANDOUT #5

Inventory Card

Item Description: Mechanical seals for well pumps #1 and #2

Quantity: Max. 4

Min. 2

Inventory Information

Date	Quantity stocked	Quantity in use	Supply Info.
1-8-73	2	2	Slippery Seal Corp. Cat. No. 4822

Module No:	Module Title: Preventive Maintenance
	Submodule Title: PM Equipment
Approx. Time: 6 hours	Topic: Instrumentation and Tools

Objectives:

Upon the completion of this submodule the learner should be able to identify and manually operate:

1. Pressure moneneters
2. Volt - ohm - Amp meter
3. Inside and outside calipers
4. Tachometer
5. E. T. meters
6. Full wrench set
7. Feeler gauges
8. Runout gauge
9. Depth gauge
10. Vacuum gauge
11. Altitude gauge
12. Lubrication apparatus
13. Thermometer

Instructional Aids:

Items listed above

Instructional Approach:

Demonstration
Physical manipulation of equipment
Discussion

References:

Manufacturers Operating Instructions.

Class Assignments:

Physical practice with equipment available

Module No:	Topic: PM Equipment (Instrumentation and Tools)

Instructor Notes:	Instructor Outline:
1. Have enough of each item listed so that each class member can physically handle and operate all of them.	A. Tools useful in a PM Program 1. Discuss the use and purpose of each of the following items: a. Volt - ohm - amp meter b. Tachometer c. Full wrench set (If not possible to obtain a full set then list missing pieces d. Inside and outside calipers e. Elapsed time meters f. Feeler gauge g. Runout gauge h. Depth gauge i. Vacuum gauge j. Pressure manometer k. Altitude gauge l. Lubrication apparatus m. Thermometer
2. Use of instruments and tools should be according to manufacturers instruction	2. Demonstrate usage: a. Use each of the items listed above in a working application, so that the learner can observe the proper usage of each item.
3. Have process equipment available so that these items listed can be used by the learner in an actual working function	3. Assign all members of the class to manually operate each of these items (small groups).
4. Divide class into groups of 3 or 4 persons	
	B. Review 1. Discuss with learners their experiences with equipment. 2. Discuss how this equipment can be used in their own working applications in their own water and wastewater facilities.

Module No:	Module Title: Preventive Maintenance
	Submodule Title: Implementation
Approx. Time: 4 hours	Topic: PM on Sample Equipment

Objectives:

Upon the completion of this submodule the learner should be able to

1. Physically locate maintenance points on randomly chosen pieces of water and wastewater equipment.
2. Explain the use of records in correllation to the sample equipment.
3. Write an emergency plan in case of process equipment breakdown.

Instructional Aids:

Handout
Equipment on hand
Overhead transparancy

Instructional Approach:

Demonstration
Discussing
Small group participation

References:

Maintenance Management Systems for Municipal Wastewater Facilities EPA-430/9-74-004.
MOP/11 - WPCF
Manual of Instruction for Water Treatment Plant Operators, N. Y. Dept. of Health

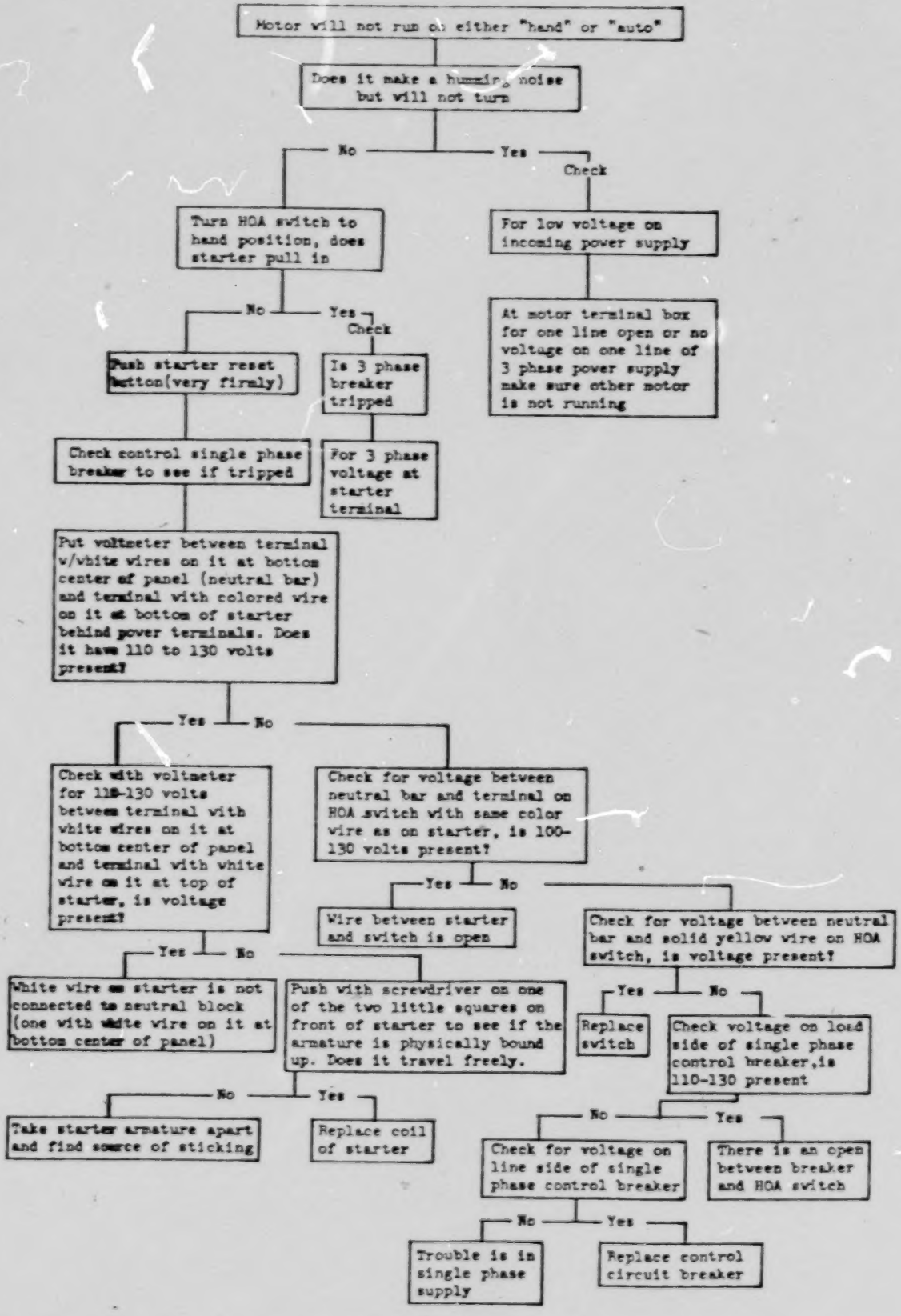
Class Assignments:

Study handouts
Read the parts of text covered in class.

Module No:	Topic: PM or Sample Equipment

Instructor Notes:	Instructor Outline:
	a. Discuss and describe PM points generally found on most water and wastewater equipment. Examples - grease fittings, electric leads, seals, bearings.
	B. Discuss working PM points into an organized records system.
Use overhead transparancy and handout	C. Describe and demonstrate how to develop a trouble shooting guide for emergency operation planning.
	D. Application
Class will divide into groups of 3 or 4 individuals. Each group will produce one set of written material. Instructor will work among groups.	1. Class will physically locate, write up PM records, and trouble shooting guide on actual pieces of water and wastewater equipment on hand.
	E. General class discussion of work accomplished in the groups.

TROUBLE SHOOTING CHART #1


Motor will not run on either "hand" or "auto"
Does it make a humming noise but will not turn
No
Yes
Check
Turn HOA switch to hand position, does starter pull in
For low voltage on incoming power supply
No
Yes
Check
Push starter reset button(very firmly)
Is 3 phase breaker tripped
At motor terminal box for one line open or no voltage on one line of 3 phase power supply make sure other motor is not running
Check control single phase breaker to see if tripped
For 3 phase voltage at starter terminal
Put voltmeter between terminal w/white wires on it at bottom center of panel (neutral bar) and terminal with colored wire on it at bottom of starter behind power terminals. Does it have 110 to 130 volts present?
Yes
No
Check with voltmeter for 110-130 volts between terminal with white wires on it at bottom center of panel and terminal with white wire on it at top of starter, is voltage present?
Check for voltage between neutral bar and terminal on HOA switch with same color wire as on starter, is 100-130 volts present?
Yes
No
Wire between starter and switch is open
Check for voltage between neutral bar and solid yellow wire on HOA switch, is voltage present?
Yes
No
White wire on starter is not connected to neutral block (one with white wire on it at bottom center of panel)
Push with screwdriver on one of the two little squares on front of starter to see if the armature is physically bound up. Does it travel freely.
Yes
No
Replace switch
Check voltage on load side of single phase control breaker, is 110-130 present
No
Yes
Take starter armature apart and find source of sticking
Replace coil of starter
No
Yes
Check for voltage on line side of single phase control breaker
There is an open between breaker and HOA switch
No
Yes
Trouble is in single phase supply
Replace control circuit breaker

Module No:	Module Title: Preventive Maintenance
	Submodule Title: Implementation
Approx. Time: 3 hours	Topic: O & M Manuals

Objectives:

The learner will describe the use of operation and maintenance manuals in relation to some specific pieces of water and wastewater equipment.

Instructional Aids:

Handout
Overhead transparancies

Instructional Approach:

Discussion
Overhead transparancies

References:

Manual of Instruction for Water Plant Operators, Health Education Service, Albany, N. Y.

MOP 11, WPCF

Operation of Wastewater Treatment Plants, Sacramento State College

Class Assignments:

Review handouts

Module No:	Topic: O & M Manuals

Instructor Notes:	Instructor Outline:
1. Hand out sample O & M manuals.	A. The O & M Manual 1. Have the learner follow through their copy of the manual making special note of: a. Start-up procedures b. All graphs and illustrations c. Emergency procedure d. Maintenance recommendations
2. Hand out copies of the pump curve. Learner will follow as the instructor demonstrates its use on overhead transparancy.	2. Pump curve a. Knowing recommended pump rates can indicate if there are problems with the pump or piping. b. The pump curve is usually part of a good O & M Manual.

4" WET WELL MOUNTED LIFT STATION

MAINTENANCE MANUAL INDEX

Description	Identification Number
Warranty	
Bulletin	606
Outline Drawing	88B101 (D)
Engineering Order	_____
Wiring Diagram	_____
Installation Instructions	
Operation and Description of Components	
Instructions for Initial Operation	
Maintenance Instructions	
Motor Maintenance Instructions	
Trouble Shooting Guide	
Service Procedures	
Pump Assembly Drawing	86D101
Mechanical Seal Replacement	
S&L Wafer Check Valves	
Vacuum Pump	Gast Model 1VAF-10-M100X
Float Check Valve	87A76

Special Information And/Or Bulletins _____

Number of Copies _____

6" WET WELL MOUNTED LIFT STATION

MAINTENANCE MANUAL INDEX

Description	Identification Number
Warranty	
Bulletin	606
Outline Drawing	86D107 (B)
Engineering Order	_____
Wiring Diagram	_____
Installation Instructions	
Operation and Description of Components	
Instructions for Initial Operation	
Maintenance Instructions	
Motor Maintenance Instructions	
Trouble Shooting Guide	
Service Procedures	
Pump Assembly Drawing	86D101
Mechanical Seal Replacement	
S&L Wafer Check Valves	
Vacuum Pump	Gast Model AVCF-13-M400X
Float Check Valve	87A76

Special Information And/Or Bulletins _____

Number of Copies _____

Smith & Loveless

SMITH & LOVELESS, Division of the Ecodyne Corporation, Lenexa, Kansas, manufacturer of the Factory Built Pump Station guarantees it to be free from defects in materials and workmanship for a period of up to one year commencing at the time the pump station is placed in operation by SMITH & LOVELESS-authorized personnel, but in no event is the pump station guaranteed for longer than 18 months from the date of shipment. This guarantee is contingent upon start-up of the pump station by SMITH & LOVELESS-authorized personnel, and the guarantee will be voided if start-up is performed by anyone else.

SMITH & LOVELESS will be the single source of responsibility to the owner for the guarantee of the pump station and all its components provided by SMITH & LOVELESS.

During the guarantee period, if any part is defective or fails to perform as specified when operating at design conditions and if the pump station has been protected prior to start-up and has been installed, operated, and maintained all in accordance with the written instructions provided by SMITH & LOVELESS, SMITH & LOVELESS will exchange free of charge a replacement for such defective part. Defective parts must be returned by the owner to SMITH & LOVELESS, if so requested.

When covered by the above guarantee, SMITH & LOVELESS will provide, without cost to the owner, such labor as may be required to replace, repair or modify the following, but no other, major components: the tank and baffle structure, pumps, pump motors, cast iron piping and valves. Except for labor provided by SMITH & LOVELESS under the preceding sentence, the cost of labor and any other expenses resulting from replacement of defective parts and from installation of parts furnished under this warranty shall be borne by the owner.

SMITH & LOVELESS will not assume responsibility for the cost of any repairs or alterations made to the pump station structure or its components unless SMITH & LOVELESS has given specific written authority therefor.

The replacement or repair of parts normally consumed in service, such as pump seals, light bulbs, oil, grease, packing, etc., are considered as part of routine maintenance and upkeep and such parts are not eligible for exchange free of charge under this warranty.

SMITH & LOVELESS makes no other warranty either express or implied and specifically disclaims any warranty as to the merchantability of the Factory Built Pump Station and as to its fitness for any particular purpose. SMITH & LOVELESS is not responsible for contingent liability or consequential damages of any nature resulting from defects in design, material, workmanship, or in delays in delivery, replacements, repairs or otherwise.

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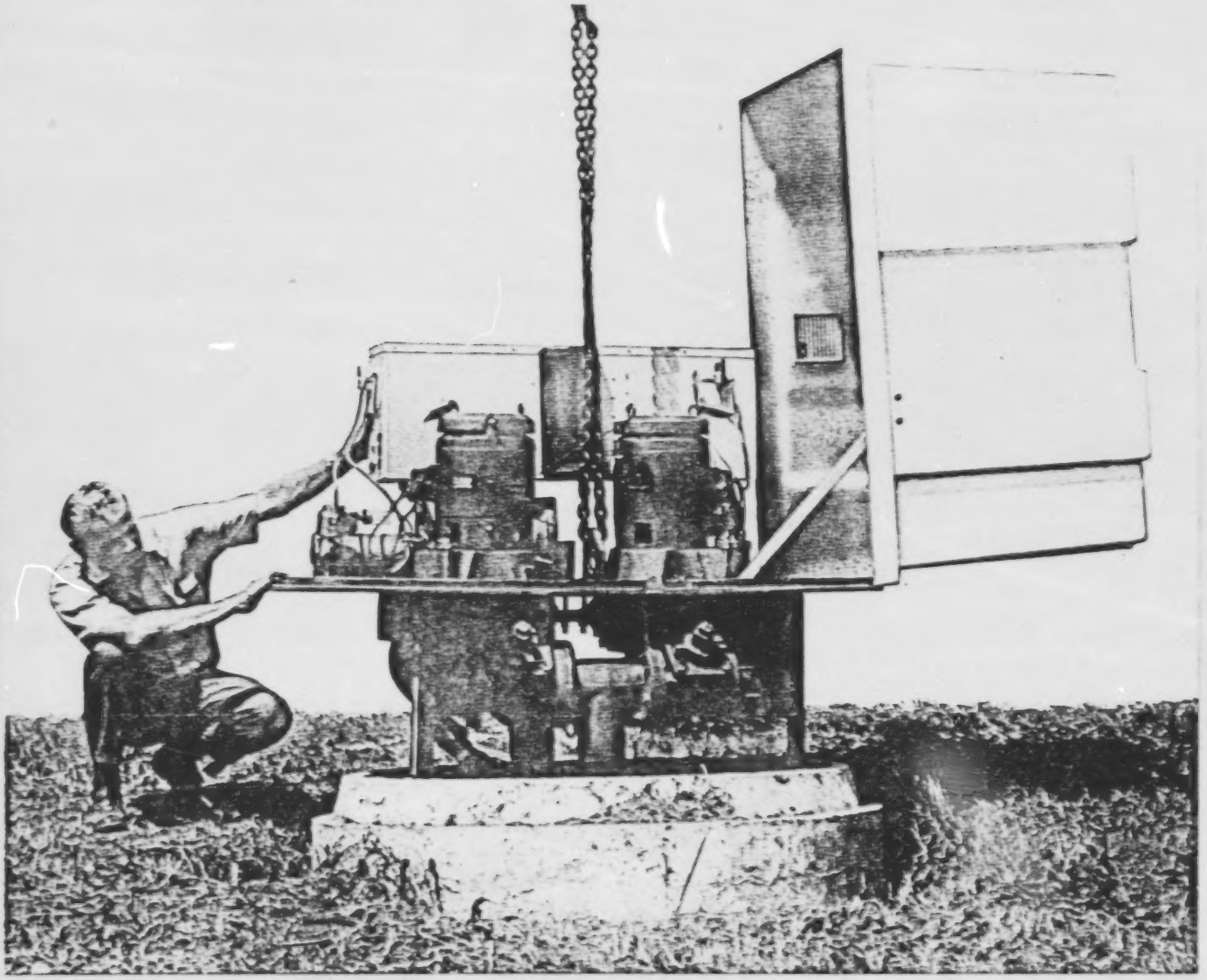
P.C. 07, 08, 09, 10, 11, 12, 13, 15, 16, 17, 18, 19

Smith & Loveless
Wet Well Mounted Pump Station



FACTORY-BUILT EXCLUSIVELY BY THE WORLD LEADER IN THE LIFT STATION INDUSTRY

- **Low Cost**
- **Easy Installation**
- **Minimum Maintenance**
- **Dependable**

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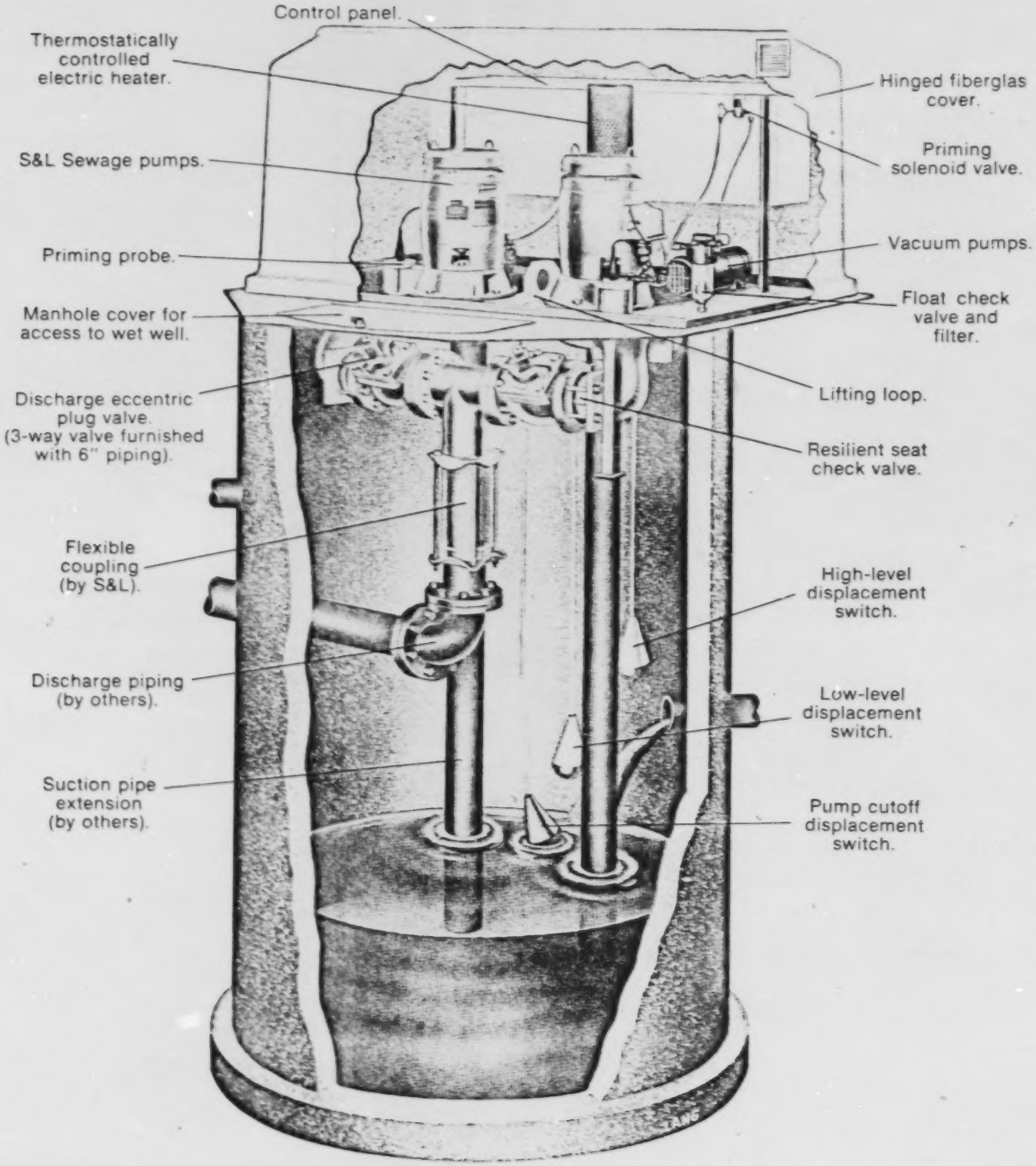
Lenexa, Kansas 66215 ®

PAGE 28 "SMITH & LOVELESS ... FIRST TO DO THINGS BETTER" REMOVED PRIOR TO BEING SHIPPED TO EDRS FOR FILMING DUE TO COPYRIGHT RESTRICTIONS.

VACUUM-PRIMED WET WELL PUMP STATION

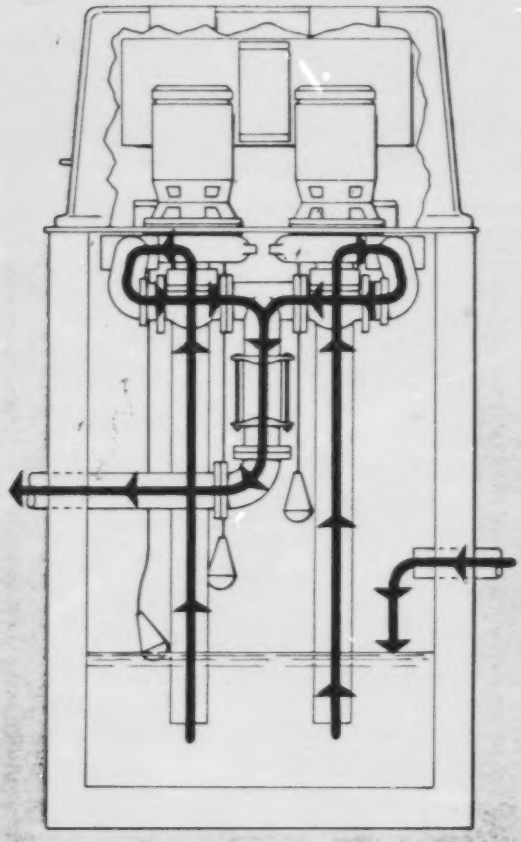
another exclusive "first" from Smith & Loveless



Patented

Smith & Loveless . . .
the world's largest manufacturer of factory-built sewage transfer and treatment equipment

The Wet Well Mounted Pump Station . . . HOW IT WORKS



When the wet well level rises sufficiently to tilt the low level ON displacement switch, the vacuum pump, connected to the base pump, will activate and prime the base pump. When the liquid level in the base pump reaches the level sensing probe the vacuum pump will shut off and the pump will immediately start.

If the inflow to the wet well is greater than the capacity of the base pump the wet well level will continue to rise and tilt the high level ON displacement switch. This will cause the standby vacuum pump to activate and prime the standby pump. As soon as the liquid level in the standby pump reaches the level sensing probe the vacuum pump will shut off and the standby pump will immediately start.

The liquid is forced up the suction pipe through the centrifugal pump, out through the discharge pipe, through a resilient seat check valve and a discharge valve into the force main.

The pumps will decrease the wet well level until the pump cutoff displacement switch tilts down and opens. This shuts off both pumps. The pumps remain primed and the vacuum pump will not come on unless the liquid level has fallen below the level sensing probe and the low level ON displacement switch has been tilted.

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Smith & Loveless Division
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Lenexa, Kansas 66215 ®

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• Helsinki, Finland • Sydney, Australia • Kingston, Jamaica

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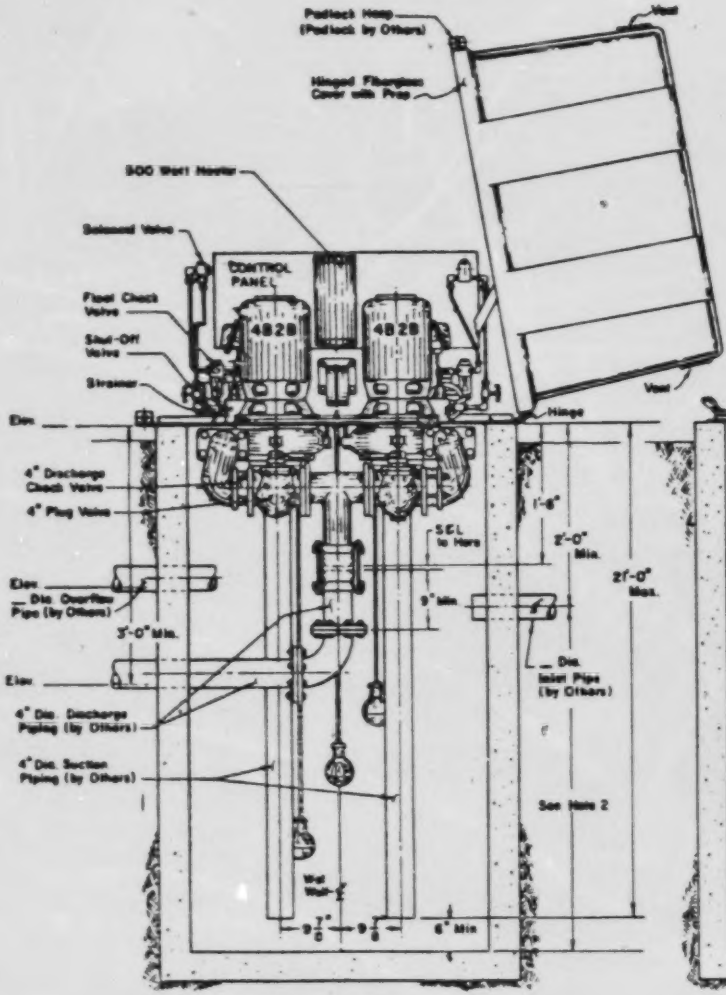
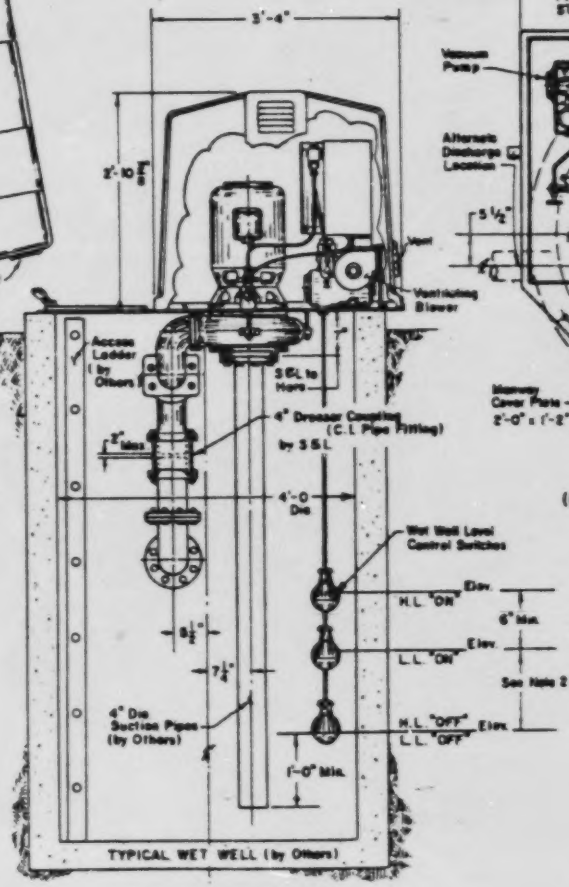
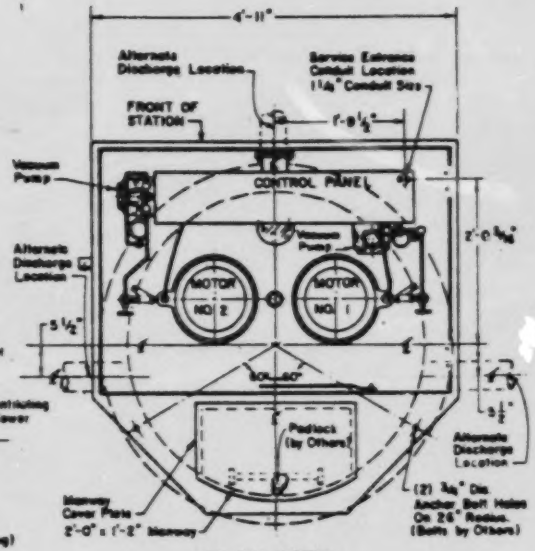
"First to Do Things Better"



SECTIONAL ELEVATION



CROSS SECTION



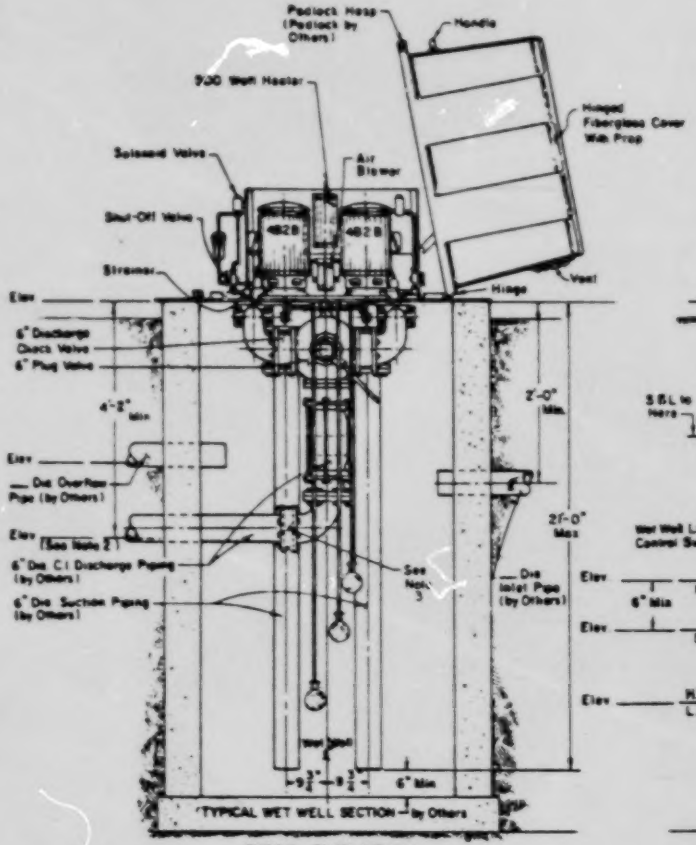
PLAN VIEW
MACHINERY CHAMBER
(COVER DELETED FOR CLARITY)

NOTES :-

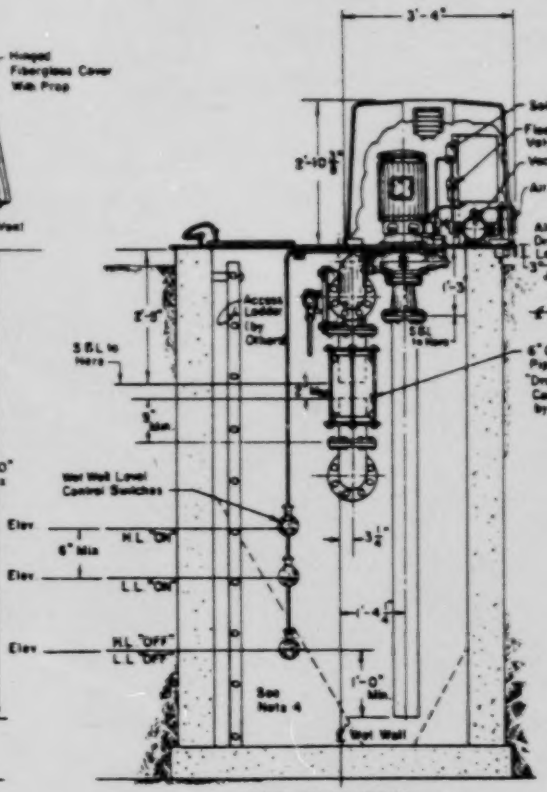
1. Maximum Capacity - 500 G.P.M.
2. Allow One Minute Cycle Time, Based On Wet Well Capacity of 94 Gal. Per Foot
3. If End of Discharge Line is Below Elevation of Discharge Line at Point of Leaving Wet Well, Consult Factory.

PATENTED IN THE U.S.A. & FOREIGN COUNTRIES

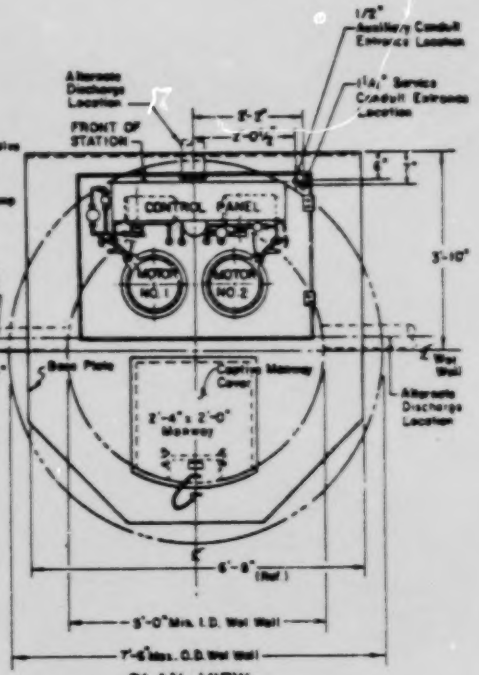
WET-WELL-MOUNTED SEWAGE PUMP LIFT STATION



REAR ELEVATION



SIDE ELEVATION



PLAN VIEW

Machinery Chamber
(Cover Deleted for Clarity)

NOTES -

1. Maximum Capacity — 600 G.P.M.
2. If End of Discharge Line is Below Elevation of Discharge Line at Point of Leaving Wet Well - Consult Factory.
3. If Discharge Line is Less Than 200 Ft. in Length, A Check Valve May Be Required - Consult Factory.
4. Provide 60° Slope in Wet Well - As Required.

PATENTED IN THE U.S.A. & FOREIGN COUNTRIES

WET-WELL-MOUNTED SEWAGE PUMPING STATION - 8 FT. - 6 FT. - ET WELLS

88 D 107

INSTALLATION INSTRUCTIONS
FOR
FACTORY-BUILT WET WELL MOUNTED LIFT STATION

Your Smith & Loveless pump station is a complete factory-built unit, including all equipment ready to operate. It has been thoroughly tested at the factory by actual operation on our test floor. Every item of mechanical and electrical equipment has been operated and found free of defects.

ELECTRICAL POWER

Lack of electrical services can create long delays in completing an installation. Therefore, it is advisable to notify the electrical contractor and/or the local power company, well in advance of the actual installation, of the requirements for the electrical service.

ELECTRICAL SERVICE REQUIREMENTS

The station requires a 3-phase, 60 cycle power supply plus a 20 ampere, 115 volt, single phase, 60 cycle control circuit supply.

A weatherproof fused disconnect switch must be provided for the station power service and a separate weatherproof fused disconnect switch for the single phase service except where 3-phase, 4-wire, 115 volt phase to ground service is provided.

All station power services must be mounted on the service pole to the station and should be the following size:

230 VOLT, 3-PHASE, 3-WIRE POWER WITH SEPARATE 115 VOLT, SINGLE PHASE SERVICE FOR AUXILIARIES				
Motor HP	Fusible Entrance Switch Size (Amperes)	Fuse Size (Amperes)	Conduit Size	Wire Size
1	30	15	3/4"	#12
2	30	20	3/4"	#12
3	30	25	3/4"	#10
5	60	45	3/4"	# 8
7-1/2	60	60	1"	# 6
10	100	100	1-1/2"	# 4
15	200	175	1-1/2"	# 2

460 VOLT, 3-PHASE, 3-WIRE POWER WITH SEPARATE 115 VOLT, SINGLE PHASE SERVICE FOR AUXILIARIES				
Motor HP	Fusible Entrance Switch Size (Amperes)	Fuse Size (Amperes)	Conduit Size	Wire Size
1	30	10	3/4"	#12
2	30	10	3/4"	#12
3	30	15	3/4"	#12
5	30	25	3/4"	#10
7-1/2	30	30	3/4"	#10
10	60	50	1"	# 8
15	100	70	1-1/4"	# 6

The sewage pumps in Smith & Loveless pump stations are equipped with non-clog impellers that pass 3" solids and very effectively handle solids commonly found in sanitary sewage: however, the pumps will not handle large rocks, bricks, sticks and other heavy materials of a similar nature. To prevent damage to the pumps, it is very important that the wet well be thoroughly cleaned before the initial start-up.

INSTALLATION

LIFTING THE STATION

The weight of a station with 4" piping will not exceed 2,000 pounds and a station with 6" piping will not exceed 3,000 pounds. The station should be lifted by hooking a sling in the lifting hooks on the base plate. The station may be lifted into place on the manhole. If the lifting device has sufficient swing, the suction pipes provided by the customer may be bolted to the suction flanges of the station and the station lifted into place as a unit. Refer to Section on Mounting Suction Pipes to assure vacuum tight connections.

CAUTION: Be sure the station is rotated so the discharge pipe will align with the force main pipe. Prior to setting the station on top of the manhole, a layer of grout should be provided on the top surface of the manhole for the station to bed down in. This gives the station firm support and reduces noise transmission.

MOUNTING SUCTION PIPES

If the suction pipes are to be mounted in place after the station is set, the length of suction pipes should be the distance from the suction flange to the bottom of the well minus six inches. Check the factory order for suction pipe size. The suction pipe furnished by the customer should have a 150 lb. steel flange or 125 lb. cast iron flange to mate with the suction flange on the station.

The suction pipes may be lowered into the wet well through the manhole outside the station. Once the suction pipe is inside the wet well, it may be rested on the bottom. The pipes can then be elevated from the bottom of the manhole so they can be bolted to the suction flanges.

The bolts, gaskets and gasket sealant required to mount the suction pipes to the station, have been supplied by the lift station manufacturer. These are located in a bag tied to the lifting loop inside the station. Coat both sides of the asbestos ring gaskets with a thin coat of the gasket sealant. (Permatex #2.) When tightening the suction flange bolts, use a crisscross pattern to assure even pressure distribution on the asbestos ring gasket. This is important because a bad connection at the suction pipes can cause a failure in the vacuum priming system.

WET WELL LEVEL CONTROLS

The lift station is provided with three displacement switches. These initiate the pumping cycle. The low level displacement switch should be installed so it hangs 12" minimum above the bottom of the suction pipe. The "LL ON" and "HL ON" displacement switches should then be adjusted so they are the distance above the bottom of the suction pipes as required. These switch levels can be adjusted by loosening the cord grip nuts inside the station and adjusting the height.

CONNECTING ELECTRICAL POWER

The station is provided with a 1-1/4" or 1-1/2" conduit connected through the base plate. Power should be brought into the station through this connection. The three 230 or 460 volt power wires should be connected to the three terminals marked "A", "B" and "C". The 115 volt single phase connection should be made to the marked terminal and the ground lug.

Briefly "jog" each pump motor using the "Hand-Off-Auto" switch and check for proper motor rotation.

REMOVE DEBRIS

A non-clog sewage pump will normally pump anything which can go through the valves, elbows and piping. All trash and debris too large to pass through the station piping must be removed from the upstream manholes before placing the station in service. Normally, such debris cannot enter a properly designed sewer system as it cannot get through house plumbing, fixtures; however, some may have been left by the workmen during construction or through vandalism.

It is much easier to remove such materials before starting up the station!

The station is now ready to start up.

NOTE: Do not attempt to start up the station until you have read this entire manual carefully, then follow the instructions step by step.

WET WELL MOUNTED PUMP STATION
OPERATION AND DESCRIPTION OF COMPONENTS

Refer to the picture in the bulletin at the front of this manual for location and orientation of components.

MECHANICAL OPERATION:

There are three switches in the wet well. These switches do not float. They tip as the water level rises about them. The tipping of the case closes a mercury switch inside the case. The intermediate level switch, when actuated, provides power to the centrifugal pump motor starter. If the pump is not primed, the vacuum pump will run until the water level reaches the electrode probe. Water touching the probe will energize the electrode relay which will cut off the vacuum pump and energize the centrifugal pump motor starter. The centrifugal pump will pump the wet well level down to low level wet well switch. The low level switch will break, shutting off the centrifugal pump. This process will repeat itself as the wet well level rises. Should one pump fail to handle the flow to the wet well or upon failure of one pump, the wet well level will rise to the high level switch. The high level switch will energize the vacuum pump of the high level centrifugal pump. When the centrifugal pump is primed, the water level will reach the probe and energize the electrode relay. This will send power from the high level switch to the motor starter of the high level pump and cut off the vacuum priming pump. Both centrifugal pumps will operate until the wet well level drops to the low level wet well switch which will cut off both pumps.

VACUUM PRIMING PUMPS

The vacuum priming pumps operate only if the wet well level calls for a centrifugal pump to operate and if the pump called for is not primed. There is a three-way solenoid valve in each priming line. When the vacuum priming pump is not operating, this valve closes off the line to the centrifugal pump. The sealed valve holds the prime in the centrifugal pump. The vacuum priming pumps are self-lubricating piston type pumps with single phase capacitor start motors requiring no lubrication. These pumps are corrosion resistant.

SOLENOID VALVES

There are 3-way solenoid valves in each priming line. These valves seal off the centrifugal pump when the vacuum pump is not operating. This holds the prime in the centrifugal pump. The 3-way valve opens the line to the float seal trap to atmosphere when the valve is de-energized. This all occurs when there is no power on the 3-way valve. When the 3-way valve is energized, the vacuum pump is connected to the centrifugal pump through the float trap. The 3-way valve is stainless steel.

FLOAT TRAP

The float trap is in the priming line to prevent any water getting to the vacuum pump. If water enters the priming line, it will fill the bowl on the float trap causing the float to rise and seal off the vacuum line. Every time the 3-way solenoid valve is de-energized, it will vent the float trap and the drain check in the bottom will open and drain the float trap.

DRAIN CHECK

The drain check is a poppet check valve that closes when a vacuum occurs in the float trap. The in-rush of air through the check overcomes the weight of the poppet and the poppet rises to the closed position. When the float trap is vented, the weight of the poppet drops it off the seat downward and opens the check to drain the contents of the float trap.

Y-STRAINER

There is a Y-Strainer at the centrifugal pump. Its purpose is to trap any debris that might accidentally enter the priming line. It is brass with stainless screen.

ELECTRICAL OPERATION

BREAKERS

There is a 120 volt single pole control circuit breaker that energizes the control circuit. This breaker powers the two electrode relays through the priming probes. The breaker powers the alternator, motor starters, vacuum pump, solenoid valves, and cooling fan.

DISPLACEMENT SWITCHES

These switches, as described before, initiate the pump cycles. They are mercury switches in a weighted float ball that tips. The power from these switches passes through the alternator.

ALTERNATOR

The alternator is a 16 hour timer that operates a micro-switch. The timer is set to change position every eight hours. The switch is double-pole,

double-throw and switches one pump from low level to high level and vice-versa.

ELECTRODE RELAY

This is a sensitive 10,000 ohm plastic encased plug-in relay. The water level in the centrifugal pump touches the probe in the pump and completes the circuit through this relay coil. The contacts of the relay interrupt the power to the motor starter if the pump is not primed and the relay de-energized. If the relay is de-energized, the contacts provide power to the vacuum pump through a control relay. The control relay also energizes the 3-way solenoid valve.

CONTROL RELAY

The control relay is a single-pole, single-throw power relay. It is energized by power from the level switches through the alternator and electrode relay. The contact of this relay is heavier duty than the other relays. The heavy contact is used to start the vacuum pump and operate the solenoid valve.

COOLING FAN

There is a non-adjustable thermostat mounted in the control panel. This thermostat operates a cooling fan. It automatically turns on the cooling fan when the temperature inside the enclosure reaches approximately 90° F. The cooling fan intake and vent louvers must be opened in warm weather and closed in cold weather. The cooling fan motor must be oiled every three months of operation.

HEATER

There is a 500 watt heater mounted on the back of the control panel. This heater is controlled by a preset thermostat. The thermostat is set to turn the heater on at approximately 40° F. The thermostat is mounted in the control panel.

An auxiliary portable heater with built-in thermostat is provided for northern climates. It is plugged into the convenience outlet.

SEWAGE PUMPS & PIPING

CENTRIFUGAL PUMPS

There are two specially designed centrifugal pumps in this station. The special volutes are mounted under the deck plate. The special motor adapter sits on the volute and is above the deck plate. The motor is mounted to the adapter. The motor adapter is hollow. The vacuum pump draws air from hole "A" as shown on Figure #1. Liquid rises from the wet well up the suction pipe filling the volute and hollow adapter until it touches the bottom of probe "B". This means that all air has been extracted from the pump. The pump can then operate pulling up the liquid from the wet well.

The pump has a specially designed mechanical seal "C". The adapter has a hole in one side to the shaft and seal mounting plate. Any seal leakage can be observed through this hole.

PIPING

The suction pipe extends from the front head "D" to near the bottom of the wet well. Liquid rises up this pipe as the impeller in the pump turns. The liquid is thrown outward in the volute. The volute conveys the liquid to the pump discharge nozzle. The liquid passes into a special elbow and to a swing type wafer check valve. The check valve has a bronze clapper and arm and a stainless steel shaft. The clapper seats against a rubber seat. An external spring loaded arm makes the valve non-slamming.

The liquid passes from the check valve to a "plug" valve. This valve has a rubber covered plug that seats against a cast iron seat. A wrench to operate the valve is provided with each station.

The liquid discharged through the stop valve passes through to the discharge line. The discharge line is connected to the station piping by a "dresser" coupling.

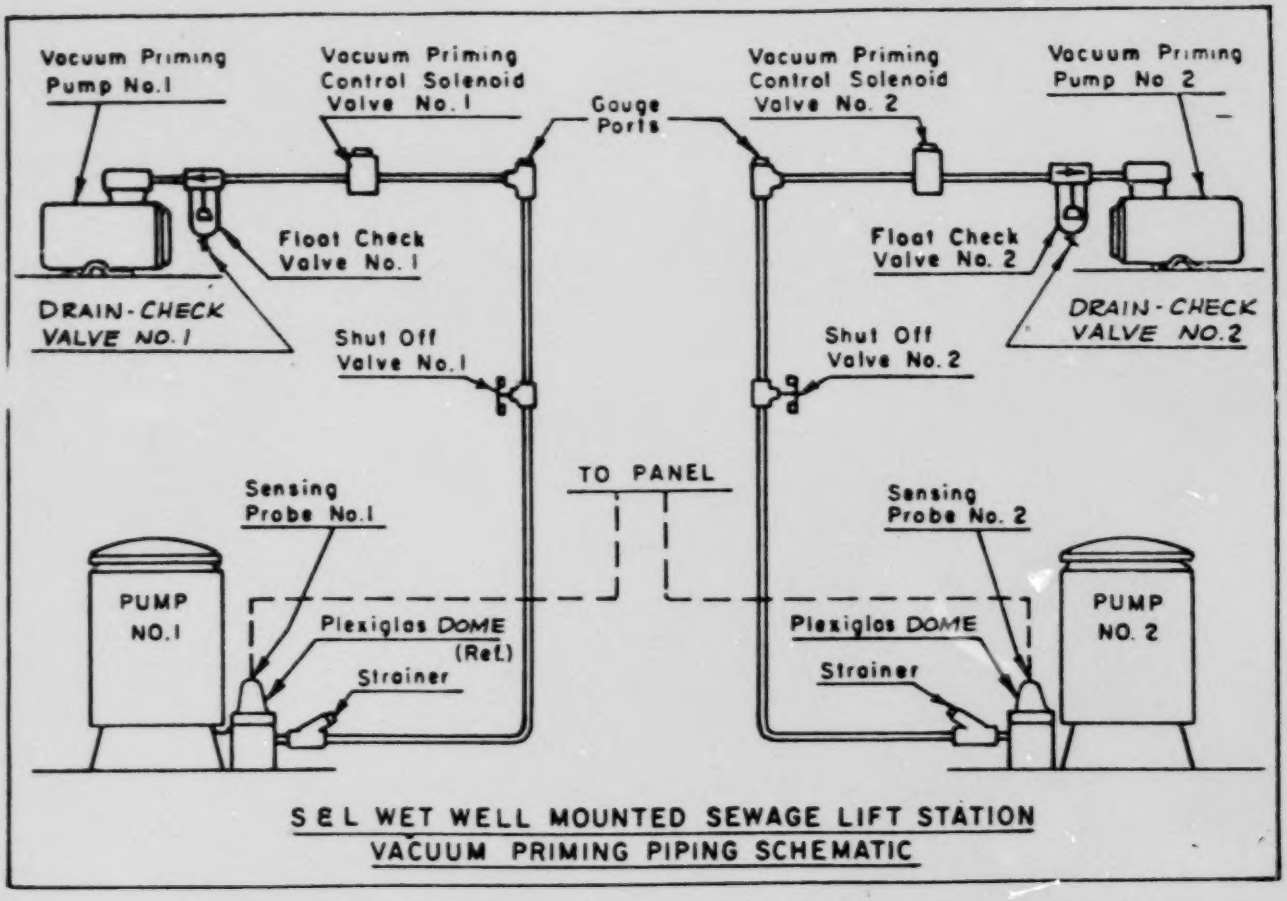
POWER SUPPLY

POWER WIRING

The power service is connected from a fused disconnect switch adjacent to the power meter to the control panel. The power wires are connected to the top of the motor breakers or to a master breaker. A ground line is connected to the ground lug. The power runs from the motor breakers to the pump starters. The power passes through the starter to overload heaters and then to the motors.

CONTROL WIRING

The 120 volt single phase power source is connected to a single pole breaker. The power is provided between this breaker and ground. The control circuit goes to the two electrode relays through a resistor and rectifier diode ahead of each D.C. plug-in relay. The coil on the relay has a condenser in parallel to iron out the 1/2 wave D.C. and to provide a time delay of one second on drop out of the relay. The other side of the relay coil is connected to the probe in the centrifugal pump adapter. The circuit to this relay is completed through the liquid in the pump to ground.



S & L WET WELL MOUNTED SEWAGE LIFT STATION
VACUUM PRIMING PIPING SCHEMATIC

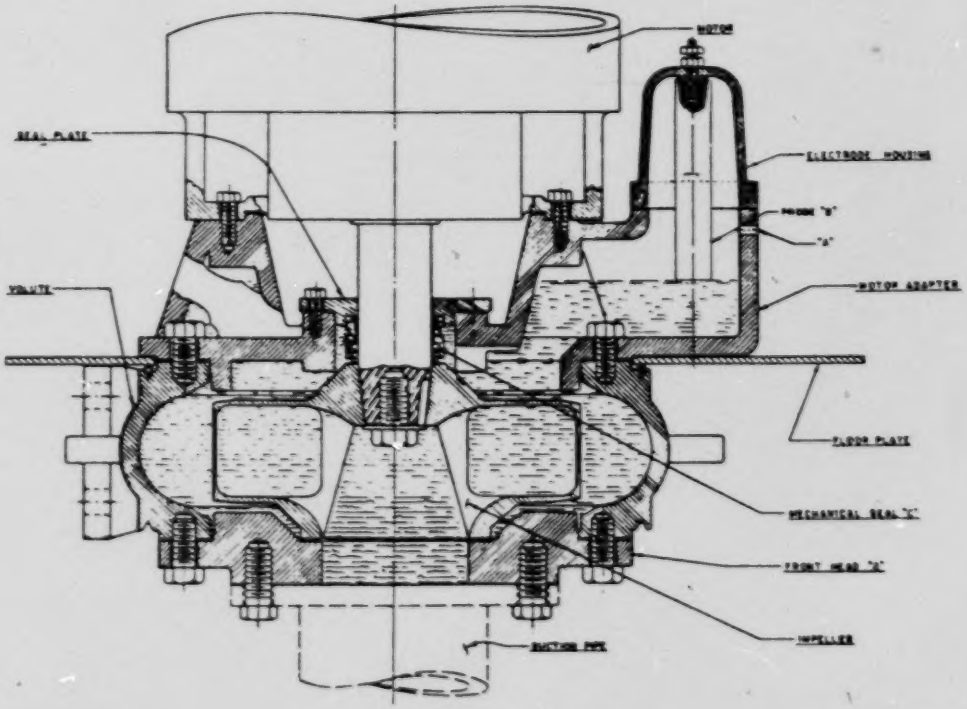


FIGURE #1

INSTRUCTIONS FOR INITIAL OPERATION
FOR SMITH & LOVELESS
FACTORY-BUILT WET WELL MOUNTED LIFT STATION

The sewage pumps in Smith & Loveless wet well mounted lift stations are equipped with "Non-Clog" type impellers that pass 3" solids and very effectively handle solids commonly found in sanitary sewage. However, the pumps will not handle large rocks, bricks, sticks and other heavy materials of a similar nature. To prevent damage to the pumps, it is very important that the wet well be thoroughly cleaned before starting up the station.

While inspecting the wet well, be sure that the liquid displacement switches are hanging freely at their proper elevation (see outline drawing in the front of the manual). Also, check the discharge plug valves to be sure that they are in the "OPEN" position.

PUMP OPERATION

The pumping cycle is controlled by three liquid level displacement switches in the wet well. With a rising wet well, the low level "ON" displacement switch is tilted and the base pump starts. If the wet well level continues to rise, the high level "ON" displacement switch is tilted and the standby pump is started. Both pumps then pump the wet well to a level below the low level "ON" displacement switch setting and the low level "OFF" displacement switch shuts off both pumps. Every eight hours the pumps are alternated so that the standby pump becomes the base pump.

START-UP

If the station has been stored for more than two weeks, especially if out-of-doors or in a moist area, refer to the "Sewage Pump Motors" section of this manual for start-up procedure. To start the station, place the single phase circuit breaker marked "CONTROL SYSTEM" in the "ON" position. If the sewage level in the wet well is above the middle float switch, the vacuum pump will begin running immediately and start priming the pump. When the sewage reaches the probe in the motor adapter housing, the vacuum pump will shut off.

If one or both of the vacuum pumps do not stop running, there is a leak somewhere in the priming system or the sewage pump piping. It is possible, since there is no sewage in the force main, that the discharge check valves may be slightly open. To eliminate this problem, close the discharge plug valves and wait until the the vacuum pumps stop running. Then start the pumps by hand and open the discharge plug valves to fill the force main. If the priming system still will not hold, the suction pipes should be checked for leaks since they are installed in the field.

If the pumps retain their prime, place the "Hand-Off-Automatic" switches in the "Automatic" position and place the No. 1 and No. 2 motor circuit breakers in the "ON" position. Also, place the automatic alternation switch in the "ON" position. Depending on the level in the wet well, either one of the pumps will start, or both pumps will start. Check both pumps for proper motor rotation. The station should now be observed for several pumping cycles to insure that the displacement switches are operating the pumps correctly as described in the PUMP OPERATION section. If the station does not operate properly, refer to the trouble shooting chart in the maintenance section of this manual for possible causes and remedies.

MAINTENANCE INSTRUCTIONS FOR SMITH & LOVELESS WET WELL MOUNTED PUMP STATION

The Smith & Loveless pump station is a complete factory-built unit including all interior equipment ready to operate. It has been thoroughly tested at the factory by actual operation on our test floor. Every item of mechanical and electrical equipment has been operated and found free of any defects. Your pump station will give continuous trouble-free service with reasonable care and maintenance. We recommend that a preventative maintenance program be established based on the following maintenance procedures. The station should be visited daily and the following items inspected during each visit:

1. Float switch operation.
2. Sewage pump operation.
3. Vacuum priming operation.
4. Sewage pump mechanical seals.
5. Water trap bottles.
6. Station cleanliness.

Once every month the following procedures should be performed:

1. Remove the electrodes from the electrode housing and thoroughly clean any coating from the electrode. Inspect the electrode housing in the motor adapter and remove any deposits or scale from the electrode housing.

   If the electrode is more than half consumed, it should be replaced.

2. Remove the water trap bottles and clean out any water deposits in the jars. Lift the float mechanism to insure that it is operating freely.

Every three months, oil the ventilating blower motor bearings.

The pump motors are provided with pre-lubricated ball bearings which under normal conditions require little or no maintenance and re-lubrication.

Caution should be taken whenever lubricants are applied to motor bearings. Thoroughly study the lubrication section of the motor maintenance section in this manual.

During cold weather, the ventilating louvers in the fiberglass cover should be closed, and during warm weather, they should be opened for cooling.

Refer to the following pages for descriptive information on making inspections and for maintaining the station equipment.

CLEANLINESS

A clean pump station is a trouble-free pump station. Clean up the station after each visit.

MAINTENANCE RECORD

Before leaving the station, record date of inspection on the maintenance sheet provided inside the lid.

For repair of any accidental damage or assistance in maintenance problems, contact the Smith & Loveless Service Department which employs a fleet of aircraft and experienced technicians to help you quickly and efficiently maintain a continuously operating pump station.

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR SMITH & LOVELESS VERTICAL PROTECTED SEWAGE PUMP MOTORS

INSTALLATION

This motor is shipped ready for immediate service. If the motor has been in storage for a long period or has been subjected to a damp atmosphere, the insulation resistance of the stator winding should be checked before start-up. (See MAINTENANCE for procedure.)

Check power supply against nameplate rating. Motors are guaranteed to operate satisfactorily within a voltage range of not more than 10% above or 10% below the nameplate voltage rating. Performance within this range will not necessarily be the same as the established performance at the exact rated voltage.

See the nameplate diagram for proper connection to 208, 230 or 460 volts. To reverse the direction of rotation of a 3-phase motor, interchange any two of the power leads. For operation of 230 volt motors on 208 volt networks (when designated permissible on nameplate), use the amperage at 230 volts for selecting overload protective devices.

INITIAL START-UP

The rotor should rotate freely when turned by hand. It should run quietly on initial start-up. Operate at normal load for a short period to check for unusual noise, heating or excessive current. Excessive current will result in overheated windings. High operating temperatures shorten insulation life. The insulation of Class A or B windings, as measured by thermometer, should not exceed the temperature rise specified on the following chart:

Enclosure	Temp. Rise for Insulation A	Temp. Rise for Insulation B
1. Protected (Gen. Purpose)	40° C.	70° C.
2. Drip-proof (Gen. Purpose)	40° C.	70° C.
3. Splash-proof and Drip-proof, fully protected	50° C.	70° C.
4. Totally enclosed (TENV, TEFC)	55° C.	75° C.
5. All others	50° C.	70° C.

(Allowable temperature rise based on an ambient of 40° C.)

MAINTENANCE

For long life and satisfactory operation, always keep the motor internally clean and dry. Windings of Smith & Loveless Protected Motors may require occasional cleaning. The windings may be cleaned by high velocity blower. The blower nozzle should be non-metallic. Gummy deposits of dirt and grease may be removed by mineral spirits. Never use gasoline or other inflammable solvents.

Long storage may allow motor insulation to absorb moisture. Use a high voltage resistance meter (megger) to check insulation resistance to ground. AIEE Standards recommend that the windings insulation resistance of clean, dry motors at room temperature should be not less than:

$$\text{Insulation Resistance} = \frac{(\text{motor rated voltage} + 1000)}{1000}$$

If the resistance is below the recommended value, the windings should be baked dry or replaced. The stator should be baked in an oven at not more than 200° F. until the insulation resistance becomes constant.

DISASSEMBLY

Should it become necessary to disassemble the motor, care should be taken not to damage the stator windings. Very careful attention should be given to keeping the bearings clean. Remove bearing cartridge screws before removing end bracket screw. (A stud of the same diameter and thread as the cartridge screws and approximately 1-1/2" longer may be used to locate the holes in the bearing cap through the end bracket upon assembly.)

Smith & Loveless Motor Bearings NEVER need to be removed unless they are to be replaced. Use a bearing puller. To install a new bearing, use steady pressure on the inner race. (To facilitate installation, heat bearings to 250° F.)

The most important single factor in securing good service from ball bearing motors is to keep dirt, dust and foreign particles out of the bearing.

1. Use only clean grease from clean containers and handle so as to keep it clean.
2. Never open a bearing housing in a dusty atmosphere.
3. Never open a bearing housing without first cleaning off all dirt from adjacent surfaces.
4. Always protect an exposed bearing by a protective cover (clean paper or lint free cloth).

LUBRICATION

Double-shielded ball bearings supplied on Smith & Loveless pump motors are lubricated at the factory. In normal service, lubrication once every year or two years is adequate since the bearing housing has an additional supply of grease. Recommended lubricant is a lithium base, general purpose grease.

When lubrication is required, proceed as follows:

1. Clean grease fitting and grease pressure relief fitting to make sure it is not plugged.
2. Add grease with a low pressure gun until grease appears at the relief fitting.

NOTE: If no relief fitting is provided, remove grease drain plug. After lubricating, run motor 10 minutes before replacing plug.

CAUTION: Avoid excessive lubrication.

1. Excessive pressure may damage bearing shield.
2. Excessive supply of grease in bearing raceway may cause overheating and premature failure.
3. Excess grease may be forced into motor housing and collect on windings, causing winding deterioration.

SERVICE FACTOR

When the voltage and frequency of a general purpose 40° C. rise protected motor is maintained at the values specified on the nameplate, the motor may be overloaded up to the horsepower obtained by multiplying the rated horsepower by the (1.15) service factor.

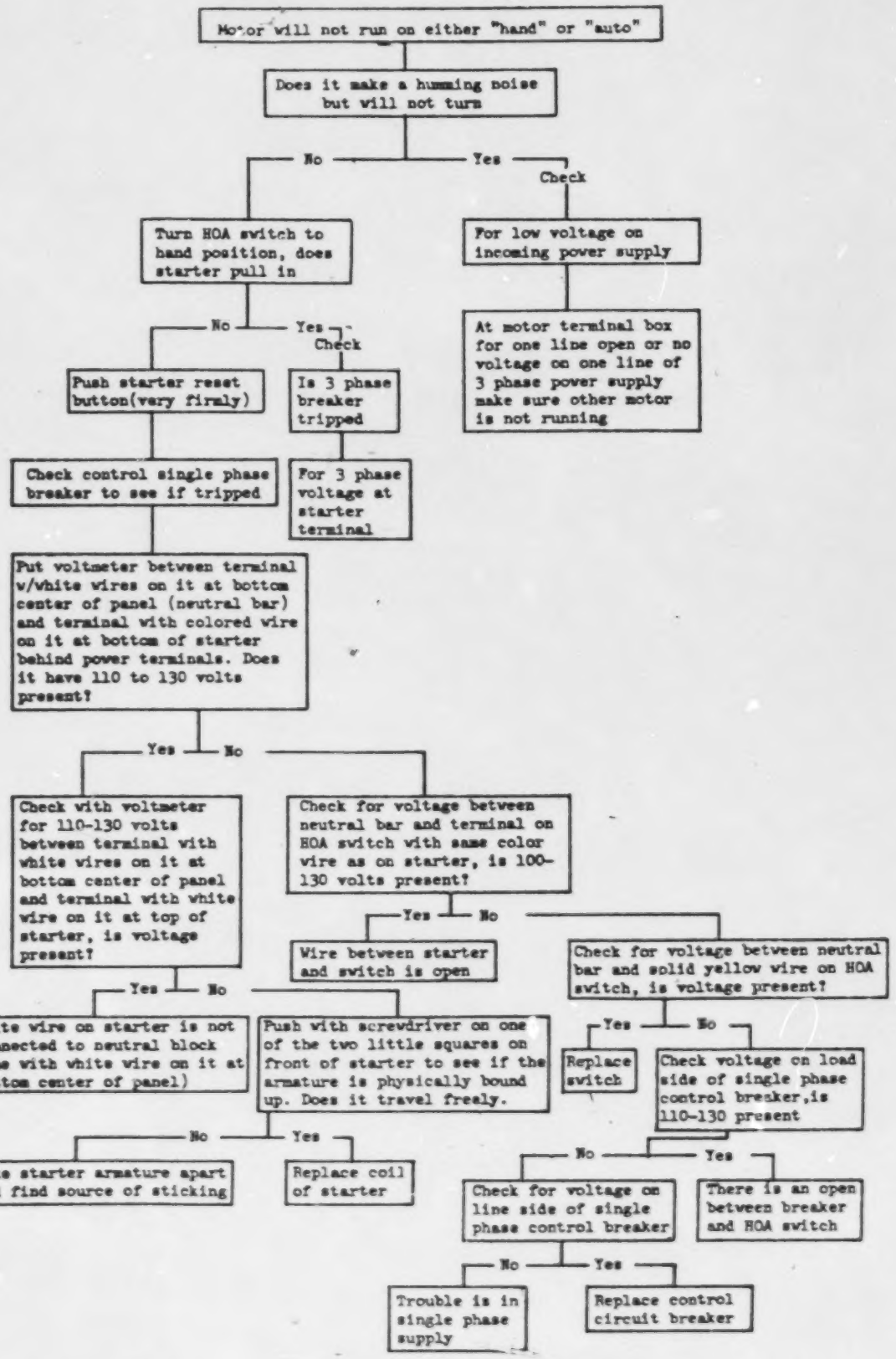
TROUBLE SHOOTING GUIDE

We have started with the premise that by trouble shooting in a systematic approach, the chances of correctly establishing the cause are greatly enhanced. As an aid in establishing a logical step-by-step method of trouble shooting, we have made the following flow charts. To use these flow charts, you must first define the problem according to the symptoms. Then find the flow chart whose heading most nearly matches your problem. In performing these checks, please remember that you are dealing with electricity and take care to perform these checks in a careful manner.

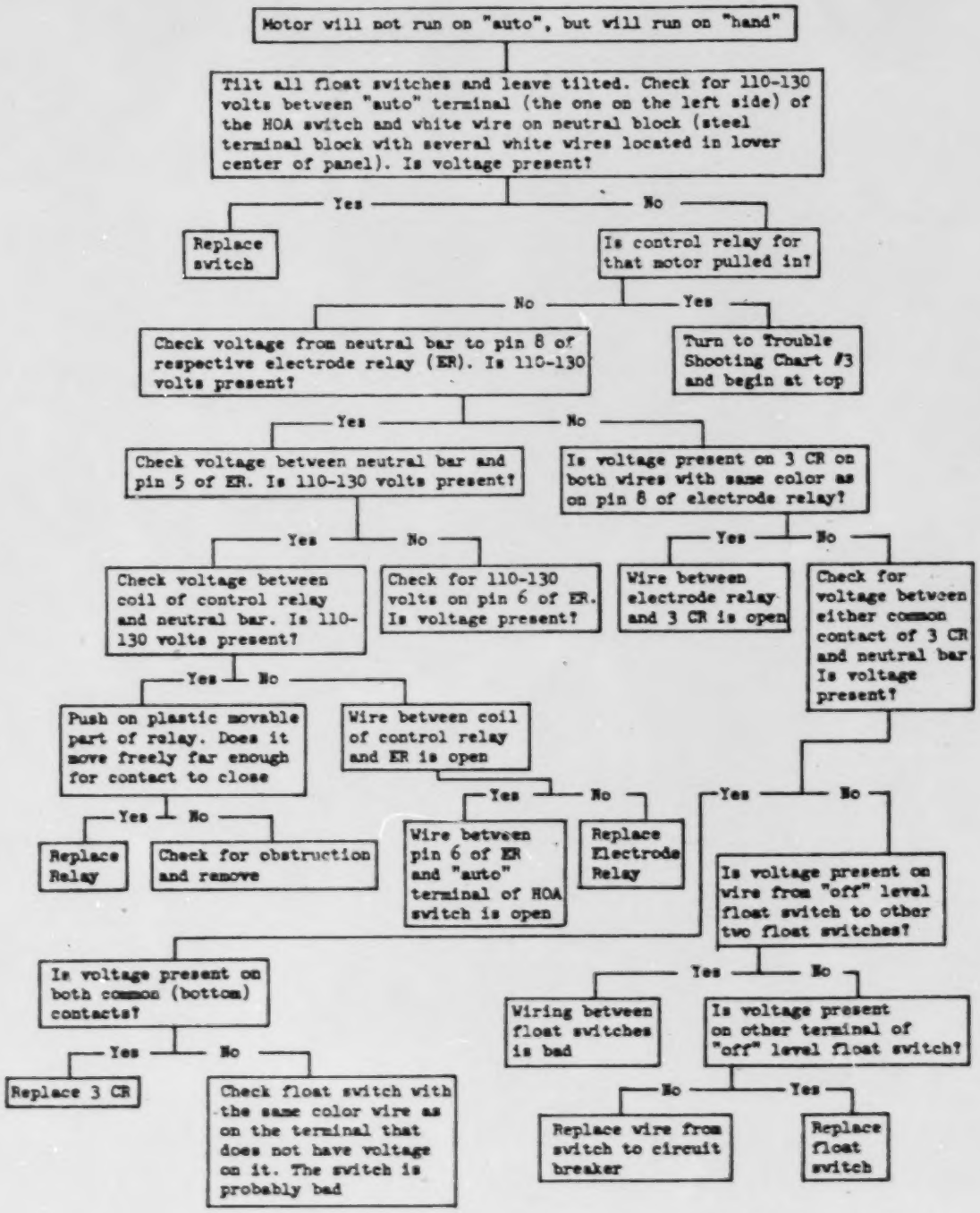
TROUBLE-SHOOTING

SYMPTOMS	SERVICE PROCEDURE
Motor will not run on either "Hand" or "Auto"	See "Trouble-Shooting Chart #1"
Motor will not run on "Auto" but will run on "Hand"	See "Trouble-Shooting Chart #2"
Pump will not prime	See "Trouble-Shooting Chart #4"
Pump loses prime while running.	Check for leaks in suction piping and vacuum system. If okay, cut 1/2" off of the bottom of the priming electrode.
Pumps cycle on and off frequently	Check float switch settings. If the "low level On" switch is below the "Low Level Off" switch, the pumps will cycle with minor changes in wet well level. If switches are set properly, check their continuity and operation.
Both pumps start together.	Check float switch settings. Be sure "High Level On" switch is above "low level on" switch. If settings are correct, check the continuity and operation of the switches.
Pump runs but does not discharge sewage.	Be sure pump is primed and discharge valves are open. Check force main for blockage. Backflush pump. On new installations, it may be possible that the static lift of the force main exceeds the maximum pumping head or that the force main is air locked. In such cases, consult the engineer.

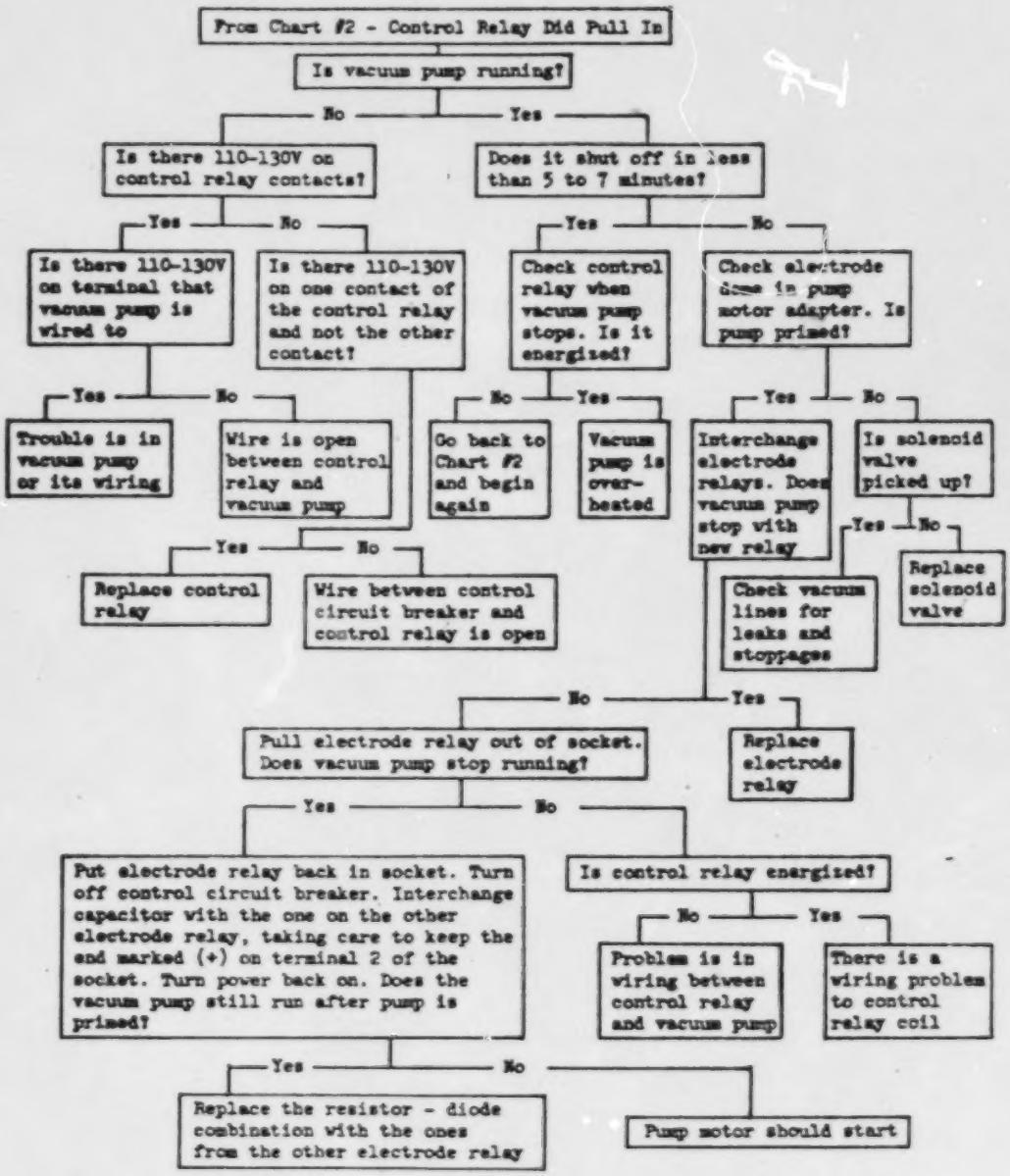
TROUBLE SHOOTING CHART #1


Motor will not run on either "hand" or "auto"
Does it make a humming noise but will not turn
No
Yes
Check
Turn HOA switch to hand position, does starter pull in
For low voltage on incoming power supply
No
Yes
Check
Push starter reset button(very firmly)
Is 3 phase breaker tripped
At motor terminal box for one line open or no voltage on one line of 3 phase power supply make sure other motor is not running
Check control single phase breaker to see if tripped
For 3 phase voltage at starter terminal
Put voltmeter between terminal w/white wires on it at bottom center of panel (neutral bar) and terminal with colored wire on it at bottom of starter behind power terminals. Does it have 110 to 130 volts present?
Yes
No
Check with voltmeter for 110-130 volts between terminal with white wires on it at bottom center of panel and terminal with white wire on it at top of starter, is voltage present?
Check for voltage between neutral bar and terminal on HOA switch with same color wire as on starter, is 100-130 volts present?
Yes
No
Wire between starter and switch is open
Check for voltage between neutral bar and solid yellow wire on HOA switch, is voltage present?
Yes
No
White wire on starter is not connected to neutral block (one with white wire on it at bottom center of panel)
Push with screwdriver on one of the two little squares on front of starter to see if the armature is physically bound up. Does it travel freely.
Replace switch
Check voltage on load side of single phase control breaker, is 110-130 present
No
Yes
Take starter armature apart and find source of sticking
Replace coil of starter
No
Yes
Check for voltage on line side of single phase control breaker
There is an open between breaker and HOA switch
No
Yes
Trouble is in single phase supply
Replace control circuit breaker

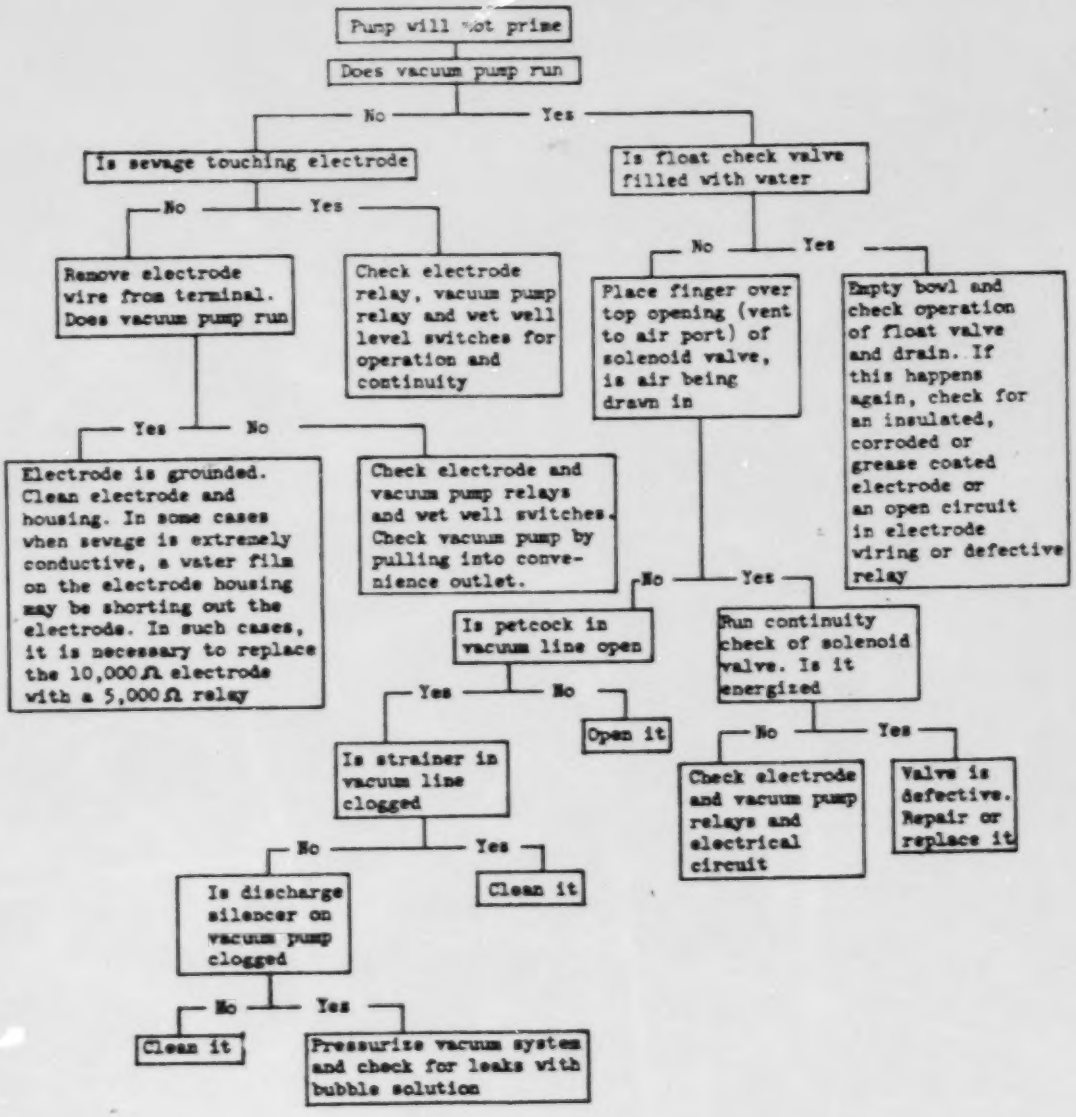
TROUBLE SHOOTING CHART #2

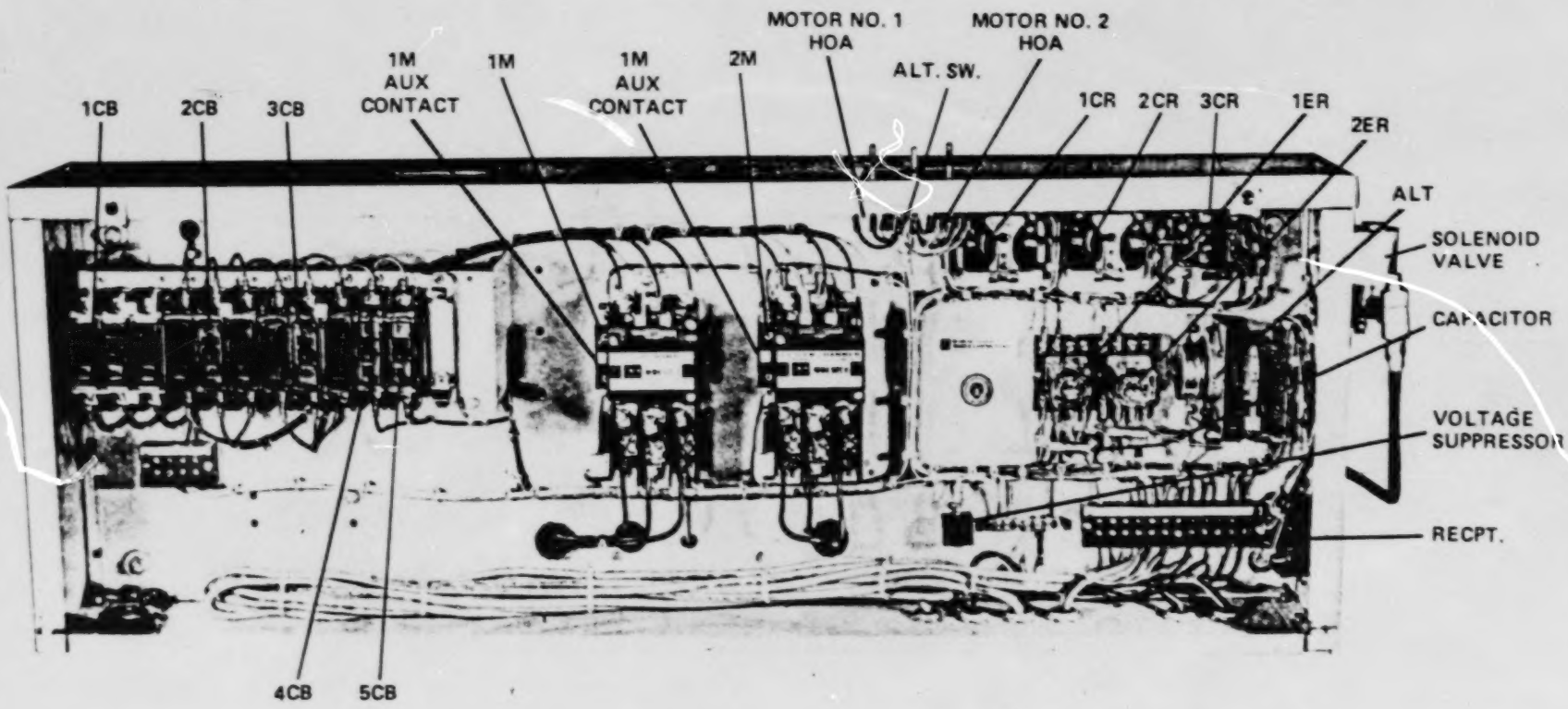

Motor will not run on "auto", but will run on "hand"
Tilt all float switches and leave tilted. Check for 110-130 volts between "auto" terminal (the one on the left side) of the HOA switch and white wire on neutral block (steel terminal block with several white wires located in lower center of panel). Is voltage present?
Yes
No
Replace switch
Is control relay for that motor pulled in?
No
Yes
Check voltage from neutral bar to pin 8 of respective electrode relay (ER). Is 110-130 volts present?
Turn to Trouble Shooting Chart #3 and begin at top
Yes
No
Check voltage between neutral bar and pin 5 of ER. Is 110-130 volts present?
Is voltage present on 3 CR on both wires with same color as on pin 8 of electrode relay?
Yes
No
Yes
No
Check voltage between coil of control relay and neutral bar. Is 110-130 volts present?
Check for 110-130 volts on pin 6 of ER. Is voltage present?
Wire between electrode relay and 3 CR is open
Check for voltage between either common contact of 3 CR and neutral bar Is voltage present?
Yes
No
Push on plastic movable part of relay. Does it move freely far enough for contact to close
Wire between coil of control relay and ER is open
Yes
No
Yes
No
Replace Relay
Check for obstruction and remove
Wire between pin 6 of ER and "auto" terminal of HOA switch is open
Replace Electrode Relay
Is voltage present on wire from "off" level float switch to other two float switches?
Is voltage present on both common (bottom) contacts?
Yes
No
Wiring between float switches is bad
Is voltage present on other terminal of "off" level float switch?
Yes
No
No
Yes
Replace 3 CR
Check float switch with the same color wire as on the terminal that does not have voltage on it. The switch is probably bad
Replace wire from switch to circuit breaker
Replace float switch

TROUBLE SHOOTING CHART #3


From Chart #2 - Control Relay Did Pull In
Is vacuum pump running?
No
Yes
Is there 110-130V on control relay contacts?
Does it shut off in less than 5 to 7 minutes?
Yes
No
Yes
No
Is there 110-130V on terminal that vacuum pump is wired to
Is there 110-130V on one contact of the control relay and not the other contact?
Check control relay when vacuum pump stops. Is it energized?
Check electrode dome in pump motor adapter. Is pump primed?
Yes
No
No
Yes
Yes
No
Trouble is in vacuum pump or its wiring
Wire is open between control relay and vacuum pump
Go back to Chart #2 and begin again
Vacuum pump is over-heated
Interchange electrode relays. Does vacuum pump stop with new relay
Is solenoid valve picked up?
Yes
No
Yes
No
Replace control relay
Wire between control circuit breaker and control relay is open
Check vacuum lines for leaks and stoppages
Replace solenoid valve
No
Yes
Pull electrode relay out of socket. Does vacuum pump stop running?
Replace electrode relay
Yes
No
Put electrode relay back in socket. Turn off control circuit breaker. Interchange capacitor with the one on the other electrode relay, taking care to keep the end marked (+) on terminal 2 of the socket. Turn power back on. Does the vacuum pump still run after pump is primed?
Is control relay energized?
No
Yes
Problem is in wiring between control relay and vacuum pump
There is a wiring problem to control relay coil
Yes
No
Replace the resistor - diode combination with the ones from the other electrode relay
Pump motor should start

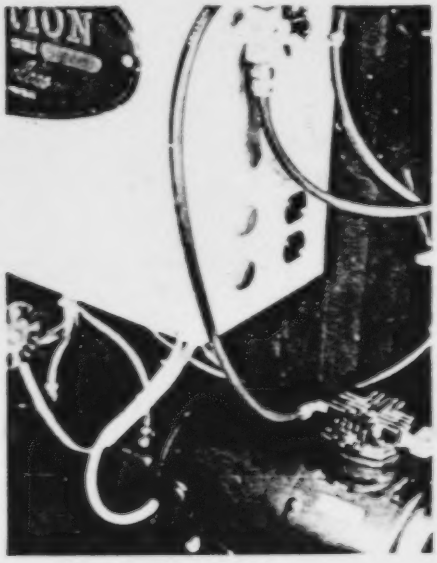
TROUBLE SHOOTING CHART #4


Pump will not prime
Does vacuum pump run
No
Yes
Is sewage touching electrode
Is float check valve filled with water
No
Yes
No
Yes
Remove electrode wire from terminal. Does vacuum pump run
Check electrode relay, vacuum pump relay and wet well level switches for operation and continuity
Place finger over top opening (vent to air port) of solenoid valve, is air being drawn in
Empty bowl and check operation of float valve and drain. If this happens again, check for an insulated, corroded or grease coated electrode or an open circuit in electrode wiring or defective relay
Yes
No
No
Yes
Electrode is grounded. Clean electrode and housing. In some cases when sewage is extremely conductive, a water film on the electrode housing may be shorting out the electrode. In such cases, it is necessary to replace the 10,000Ω electrode with a 5,000Ω relay
Check electrode and vacuum pump relays and wet well switches. Check vacuum pump by pulling into convenience outlet.
Is petcock in vacuum line open
Run continuity check of solenoid valve. Is it energized
Yes
No
Open it
No
Yes
Is strainer in vacuum line clogged
Check electrode and vacuum pump relays and electrical circuit
Valve is defective. Repair or replace it
No
Yes
Clean it
Is discharge silencer on vacuum pump clogged
No
Yes
Clean it
Pressurize vacuum system and check for leaks with bubble solution

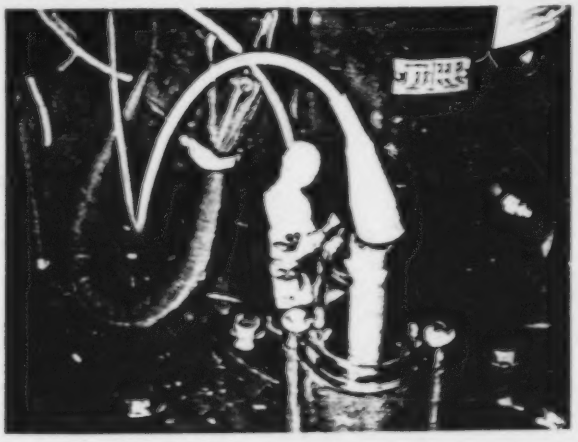

1CB
2CB
3CB
1M AUX CONTACT
1M
1M AUX CONTACT
2M
MOTOR NO. 1 HOA
ALT. SW.
MOTOR NO. 2 HOA
1CR
2CR
3CR
1ER
2ER
ALT
SOLENOID VALVE
CAPACITOR
VOLTAGE SUPPRESSOR
RECPT.
4CB
5CB

Checking for Vacuum Leaks in Seals and Piping

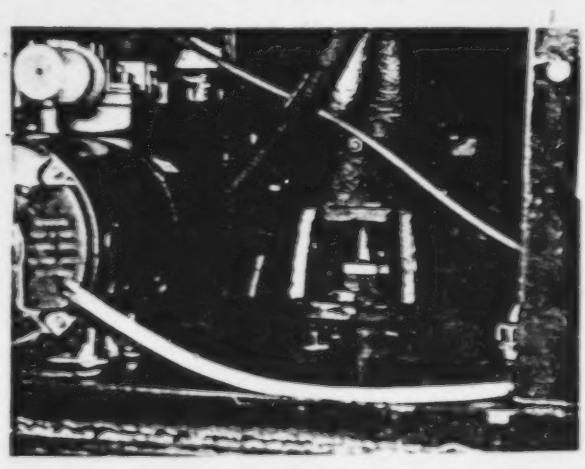
To pressurize the system, close the discharge plug valve and turn the control circuit breaker off. Check one vacuum system at a time as follows: Remove the discharge silencer from the vacuum pump and connect a piece of flexible tubing (you may borrow a piece of tubing and the fittings from the other vacuum system) from the vacuum pump discharge port to the gauge connection on the tee by the solenoid valve. Turn the vacuum pump on. Look into the wet well system. When you see air bubbling from the suction pipe, the system is pressurized and ready to be checked. (The wet well should be as high as possible to create more pressure on the system and make it easier to detect leaks). Put a soap solution that bubbles easily, preferably a children's bubble blowing soap, into a sprayer type bottle. Then spray all joints, connections, and seams that could be leaking and watch for bubbles. If a leak cannot be found inside the machinery chamber, then the piping below the floor plate must be checked, then connect the compressor to the tee in the other vacuum system and check it in the same manner. To check for seal leakage, use the following procedure while the system is pressurized. Stir a quantity of the soap solution referred to above until you obtain a large amount of suds. Fill the access opening to the seal housing with suds. If air is leaking through the seal, it will blow the soap suds away from the opening.



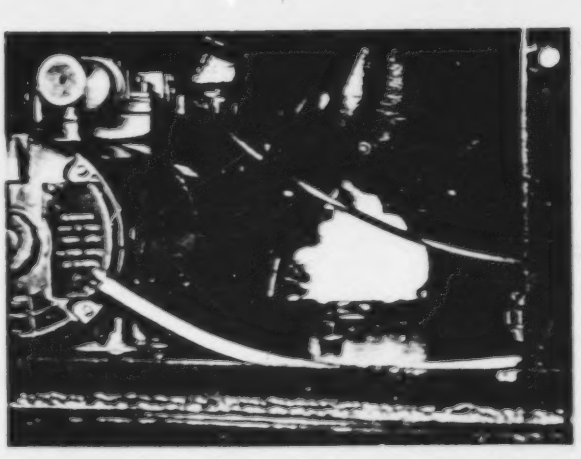
Vacuum Pump Connected To Pressurize Priming System



Checking a Connection for Leakage



Seal Access Opening



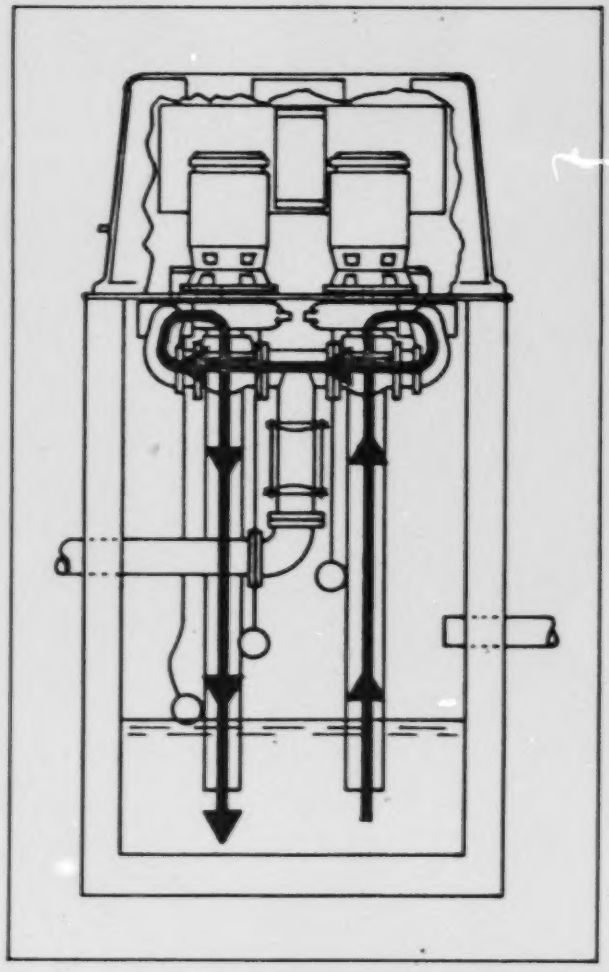
Checking a Seal for Leakage

Backflushing a Clogged Pump

If a pump becomes clogged with foreign material, such as unusually large objects, or an accumulation of rags, etc. it will run "rough" and vibrate. These symptoms also appear when a pump is running unprimed, so check first to see that sewage is touching the electrode.

To back flush a pump and its piping, first be sure that the sewage level in the wet well is at least a foot above the bottom of the suction pipes. Then close the discharge valve and manually open the check valve of the offending pump and secure the valve in this position by tying or wiring the handle in the up position. Then reopen the discharge valve. When backflushing stations with 6" piping, which use a 3-way discharge plug valve, turn the valve so that the outlet from the valve to the force main is closed. Manually run the other pump for 1 or 2 minutes so that it will pump into the discharge of the blocked pump and back out the suction line into the wet well. Any obstruction freed by backflushing will appear in the wet well and should be removed so that it does not re-enter the pumps. Do not allow sewage from the force main to overflow the wet well. When closing the check valve, do not allow it to "slam" as this may damage the valve.

Normally this will clear any obstruction from the pump or piping. If not, it will be necessary to remove the rotating assembly from the pump and clean out the blockage by hand.



Cleaning Electrode Probe

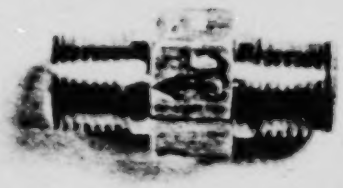
Turn off control circuit breaker. Remove the two capscrews holding the domed plastic electrode housing. Inspect the electrode probe for corrosion. If it is more than half consumed, it should be replaced. Clean the plastic housing. Scrape any corrosion from the metal probe. When reassembling, be sure that the gasket is in good condition and that the electrical connection at the top is tight.

Servicing the Float Check Assembly

Remove the plastic bowl from the float check assembly and raise the bell shaped float manually. If it does not move up and down freely, it must be disassembled and cleaned. Unscrew the filter and float assembly from the metal body and clean and flush it with soapy water. Do not attempt to disassemble the filter and float assembly further. After reassembly, recheck the operation of the float. It should not bind when raised and should drop freely by its own weight when released.

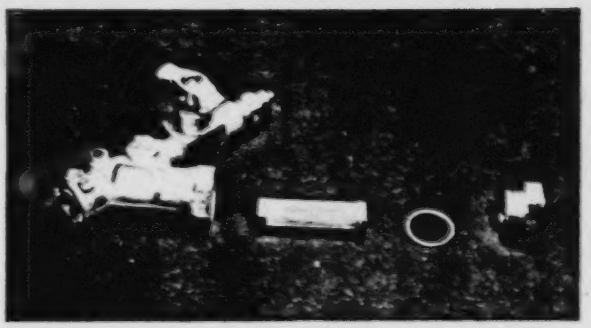
Servicing the Drain Check Valve

Unscrew the drain check valve from the bottom of the float check bowl. This valve is not disassembleable, but should be cleaned by soaking in a solvent which will not damage neoprene or brass. Thoroughly flush any foreign material from the valve and check its operation by blowing through it. Air should pass freely in the direction of the arrow, but not the other way. When reassembling the drain check valve to the float bowl, be sure that the arrow on the valve points downward.



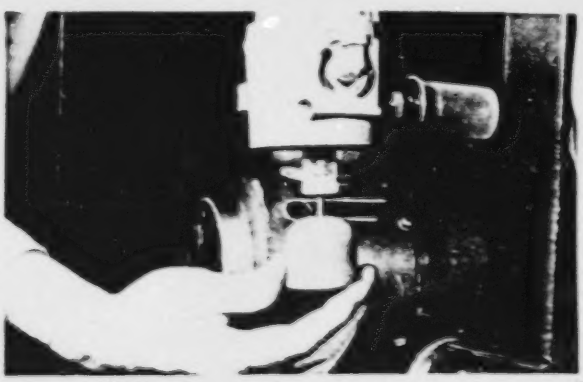
Cleaning the Vacuum Line Wye Strainer

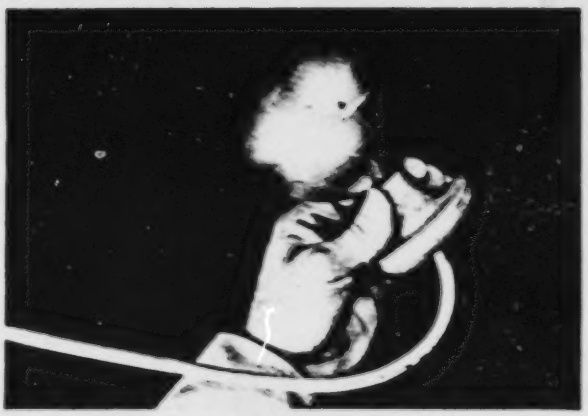
The Wye strainer is located in the vacuum line near the electrode housing. The strainer element is removed by unscrewing the hex plug on the side. Carefully clean the strainer screen using soapy water or kerosene. Remove any foreign material from inside the strainer body and reassemble the unit.



Checking Wet Well Level Float Switches

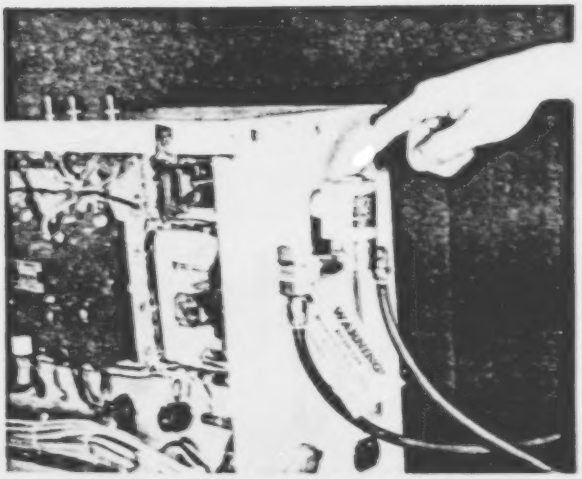
Inspect the float switches for visible damage. If the cord is cut or loose, or the ball punctured, it will be necessary to replace the switch. Shake the ball to see that no water is inside. If you cannot make the pumps operate by tipping the switch manually, run a continuity check to test the mercury switch and wiring.





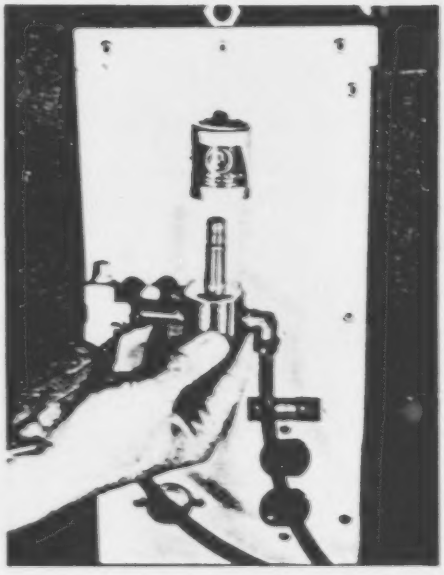
Checking the Solenoid Valve

With the vacuum pump running, place your finger over the opening on top of the proper solenoid valve to see if air is being drawn in. If air is flowing into the valve through this port, and the valve is energized, the valve must be repaired or replaced. Run a continuity check on the coil of the valve.



Disassembling and Cleaning the Solenoid Valve

Removing the nut on the very top of the valve will allow the entire valve assembly to be pulled down out of the coil. Unscrew the "stem" from the valve by using a wrench on the flats at the bottom of the "stem". Inside the "stem" is a valve poppet and a spring. Clean all internal parts in kerosene and clean out any foreign material from the openings inside the valve body. Inspect the rubber seats in the valve poppet for damage or wear, and use a new poppet if necessary. Reassemble the valve and check its operation.



Servicing the Vacuum Pumps

Refer to the manufacturer's bulletin in the back of this manual for service procedures.

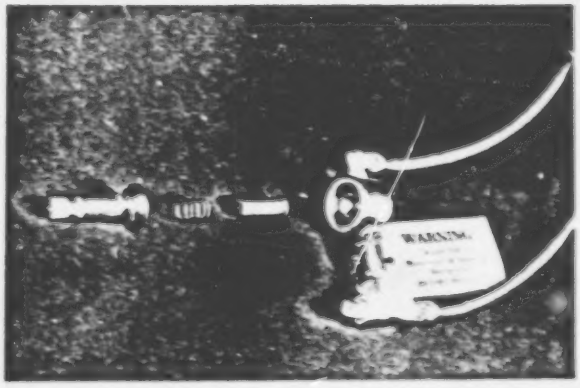
Notes on Priming

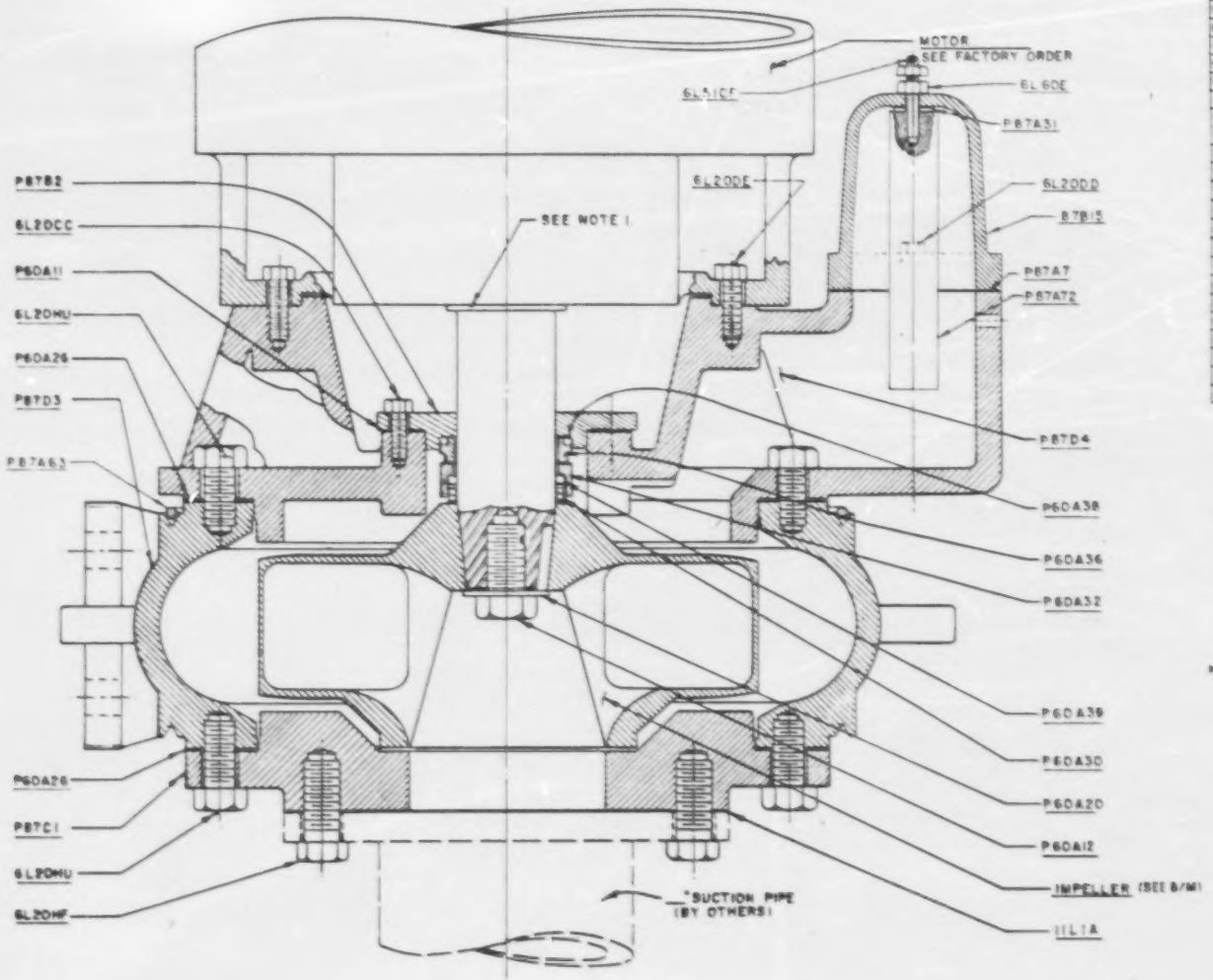
Occasionally, due to the location of the inlet to the wet well and the influent flow rate, air will be entrained in the sewage. Entrained air may accumulate in the sewage pumps and cause them to lose prime, or make priming very difficult. The remedy for this is to baffle the inlet to the wet well so that the incoming flow does not fall near the suction pipes.

When a station is first started up, or if the discharge force main slopes downward from the station, there will be no water in the discharge line to help hold the discharge check valve closed and seal it. This may allow vacuum leaks through the check valve.

In the case of a new station, the discharge plug valve may be closed temporarily or the check valve handle held down to obtain initial prime, and thereafter the discharge force main pressure will hold the check valve closed.

In the case of a system where the force main drains by gravity, it may be necessary to add an upturned ell and length of pipe at the outlet to prevent draining. Another solution is to elevate the force main at one point and install a siphon break valve.





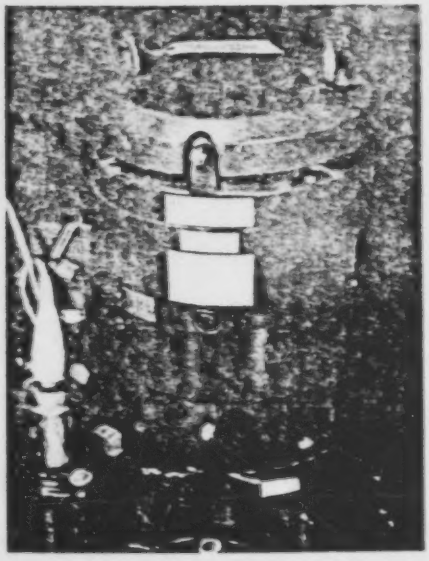
PARTS LIST		
PART NO.	QUAN	DESCRIPTION
P60A11	1	GASKET - SEAL HOLDER
P60A12	1	BOLT - IMPELLER
P60A20	1	WASHER - IMPELLER
P60A26	As Req'd	GASKET - VOLUTE
P60A30	1	SPRING
P60A32	1	SEAL - ROTATING - CERAMIC
P60A36	1	SEAL — STATIONARY - CARBON
P60A38	1	QUAD RING - STATIONARY SEAL
P60A39	1	"O" RING - ROTATING SEAL
B7B15	1	COVER - ELECTRODE
P87A7	1	GASKET - ELECTRODE COVER
P87A72	1	ELECTRODE
P87B2	1	SEAL HOLDER
P87C1	1	HEAD - FRONT
P87D3	1	VOLUTE
P87D4	1	ADAPTER - MOTOR
6L20CC	3	CAP SCREW - 5/16-18 x 1" Lg - Cad Plte
6L20DD	2	CAP SCREW - 3/8-16 x 1 1/4 Lg - Cad Plte
6L20DE	4	CAP SCREW - 3/8-16 x 1 1/2" Lg - Cad Plte
6L20HF	8	CAP SCREW - 5/8-11 x 1 3/4" Lg - Cad Plte
6L20HU	8	CAP SCREW - 5/8-11 x 1 3/8" Lg - Cad Plte
6L5ICF	1	STUD - 1/4-20 x 2" LG — Cad Plte
6L6DE	2	HEX NUT - 1/4-20 - Cad Plte
P87A31	1	GASKET - ELECTRODE
11L1A	1	GASKET - 4" FLANGE
P87A63	1	"O" RING - GASKET

NOTE 1. NEOPRENE SLINGER RING AND STAINLESS STEEL IMPELLER KEY INCLUDED WITH MOTOR

4B2B
PUMP ASSEMBLY

HOW TO REPLACE THE MECHANICAL SEAL UNITS ON SMITH & LOVELESS PUMPS

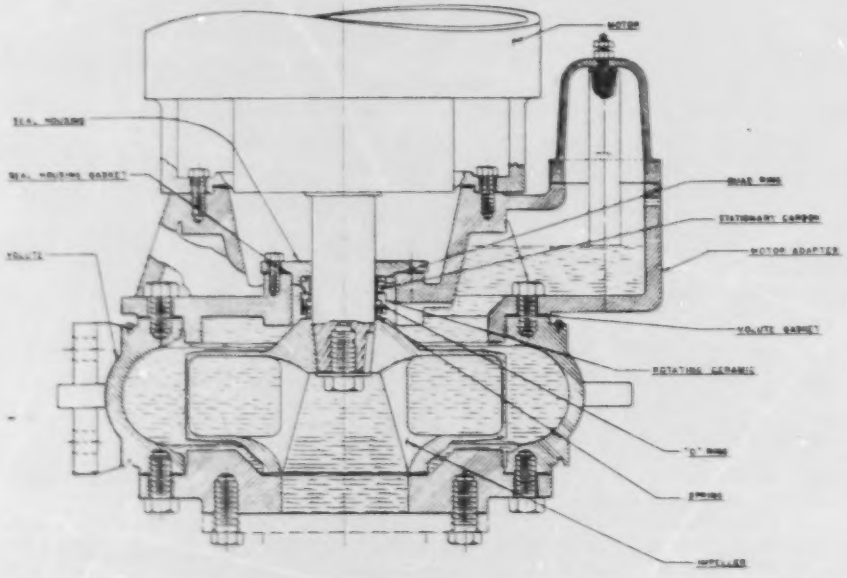
Smith & Loveless "Non-Clog Sewage Pumps are designed for maximum accessability, easy maintenance and speedy replacement of all components subject to wear.



The mechanical seals on Smith & Loveless Pumps are the most satisfactory seals for lift station sewage pumps. In normal service, a seal may be expected to last a minimum of one year. Seal life is usually considerably longer than this. Seal life is determined mainly by the amount of lubrication it receives, the "pumping head" and the material to be handled. Sewage containing sand, rocks, sticks and other debris can clog the pump or lodge in the impeller, causing excessive vibration and reducing seal life.

Periodically, it becomes necessary to replace the mechanical seal. The pump has been designed so that the seal may be replaced with a minimum of time and effort. Follow the instructions carefully.

SEAL ASSEMBLY DRAWING



HERE ARE THE TOOLS YOU WILL NEED TO REPLACE THE MECHANICAL SEAL:

1. 9/16" - 1/2" box end wrench.
2. 15/16" - 1" open end wrench.
3. 1-1/8" socket.
4. 6" T-handle 11" x 1/2" drive.
5. 1/2" x 5-1/2" drive extension.
6. #3 rawhide mallet.
7. Ratchet type hoist.
8. Motor lifting bar.
9. 2" x 6" x 12" board.
10. Lint free cloth.
11. Waterless hand cleaner.
12. Piece of plywood or heavy cardboard 10" dia.

The mechanical seal consists basically of a carbon, a ceramic and a stainless steel spring (See Fig. 1). The flat or "lapped" surface of the carbon is held against the lapped surface of the mating ceramic by pressure from the stainless steel spring to form a "dead-tight" seal.

The lapped surfaces of the carbons and ceramics are machined to a flatness of one light band (one millionth of an inch) and should be handled carefully to prevent chipping or marring them. The carbon is held stationary in the seal plate by a "Quad" ring. The ceramic is secured to the motor shaft by an "O" ring and rotates with the motor shaft. The ceramic will, however, slide on the motor shaft vertically as the spring automatically adjusts for wear.

To disassemble the pump and replace the mechanical seal, follow these instructions carefully:

First, throw motor circuit breaker at the top of control panel to "OFF" position. Then, turn the selector switch on the control panel for the offending pump to "OFF" position and leave it off throughout the operation. Turn off the control circuit breaker. Disconnect the electrode probe wire. Insulate exposed wire and place in protected place. Turn on control circuit breaker. Disconnect priming line.

CAUTION: Check to make sure that the correct (offending) pump has been disconnected disconnected turning the selector switch for the other pump to the "hand" position. This should start the other pump. If so, switch it back to "AUTO" and proceed: Turn the alternator switch to the pump not being worked on.

CLOSE DISCHARGE PLUG VALVE.

Place the "L" shaped motor lifting arm in its socket between the pumps in the base plate.

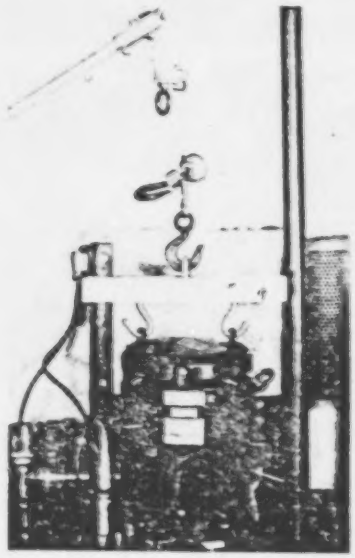
Hook a ratchet type hoist on the lifting arm and connect motor lifting bar to the lifting eyes on top of the motor.

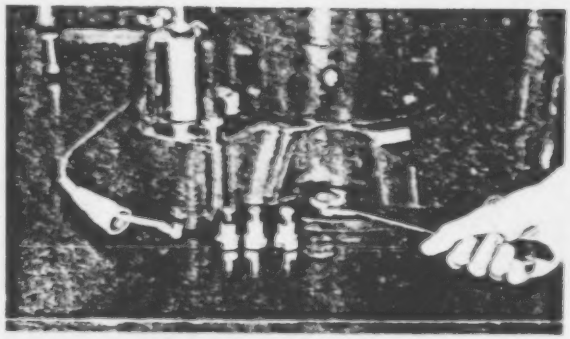
Using the 15/16" box end wrench, remove the four 5/8" hex-head cap screws that bolt the motor adapter to the volute.

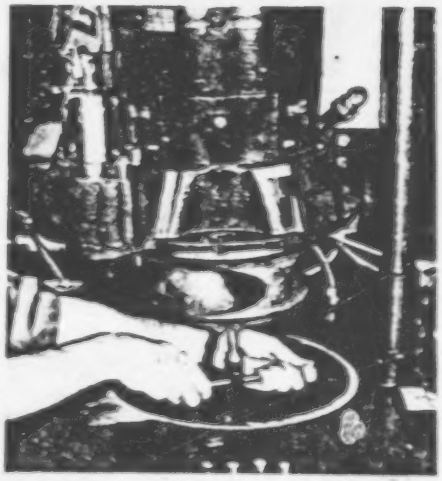
Raise the motor impeller assembly above the volute high enough to gain access to the impeller locking bolt.

Place a disc of plywood or heavy cardboard down inside the volute, covering the suction opening, to avoid losing parts down the suction pipe.

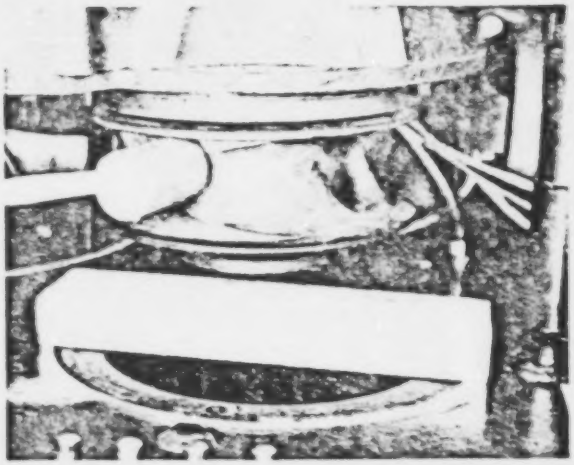
Using the 1-1/8" socket, remove the impeller locking bolt.







Place the piece of lumber directly under the impeller and lower the motor with the ratchet-hoist until the bottom of the impeller is approximately 1" above the board.

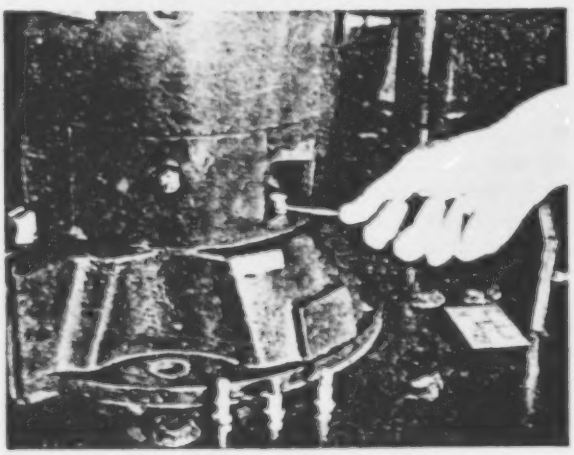


With the non-metallic mallet, strike the impeller a sharp blow on the side (in a place where the metal is relatively thick) and the impeller should drop down easily onto the board. The motor shaft is tapered so that the impeller should be easily removed.

Raise the motor assembly clear of the impeller and remove the key from the motor shaft. Then remove the seal spring from the motor shaft.

Set the impeller and board aside and lower the motor assembly back onto the volute.

Using the 9/16" box-end wrench, remove the four 3/8" hex-head cap screws that bolt the motor adapter to the motor. Raise the motor clear of the motor adapter. The rotating ceramic and its "O" ring will drop loose into the volute onto the plywood or cardboard disc.

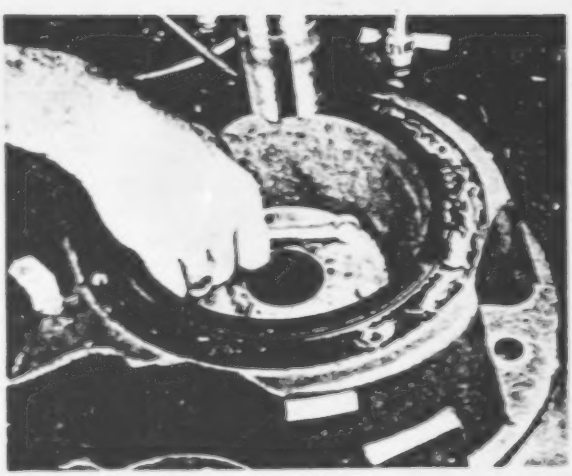


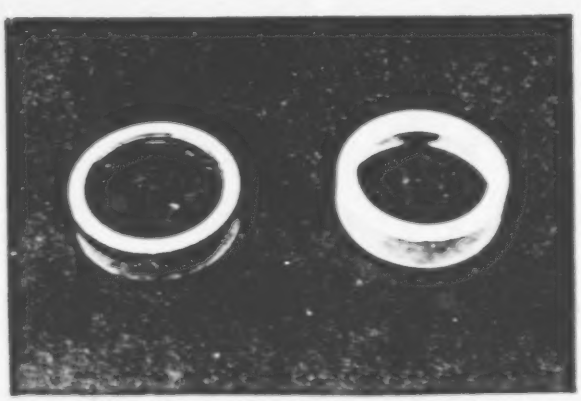
The seal plate is detached from the motor adapter removing the 5/16" cap screws. The seal plate contains the stationary carbon and its "Quad" ring.

Take out the old seal parts from the seal plate and volute.

Carefully inspect the ceramic element for wear, cracks or chips. If it is not damaged, it may be reused after cleaning.

Clean the seal housing with a good commercial solvent and wipe dry with a lint free cloth. Carefully remove the new seal from the container. Assemble the new seal in the seal housing carefully. The parts can be damaged. First, place the "Quad" ring on the carbon, and the "O" ring on the inside of the ceramic.

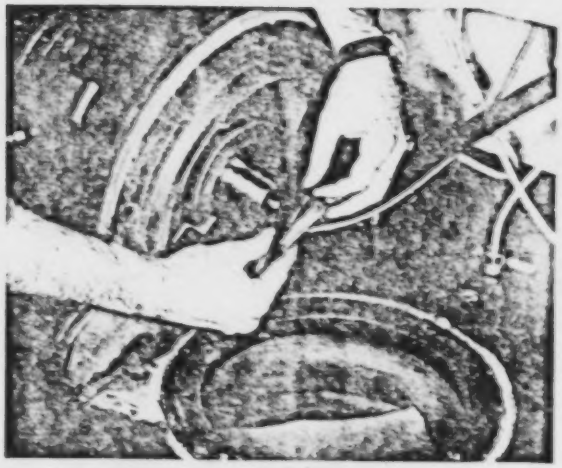




Cracked Ceramic (Left) Must Be Replaced.
Reusable Ceramic (Right).

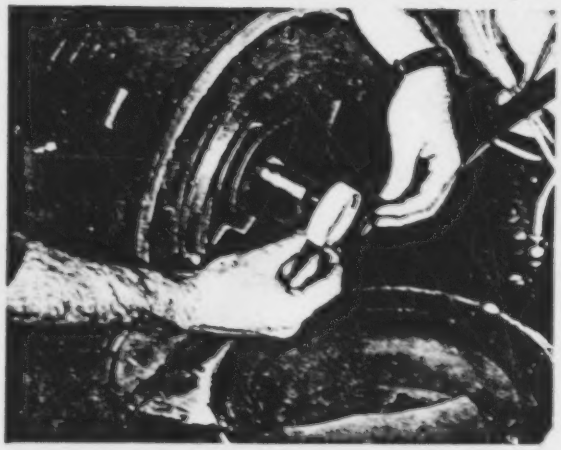
REASSEMBLY

Using a new gasket, install the seal plate assembly on the adapter. Set the adapter on the volute. Lower the motor carefully so the shaft passes through the seal plate. Bolt the adapter to the motor. Tip the motor and adapter over so the motor rests on its side. Be careful not to pull the motor conduit and wiring loose. Place the carbon over the end of the motor shaft with the "Quad" ring toward the motor. Slide the carbon into the seal plate. Carefully slide the rotating ceramic and its "O" ring onto the motor shaft with the lapped surface toward the motor. Be careful as the "O" ring passes the motor shaft keyway so the keyway edges will not cut the "O" ring. Use the seal spring to press the rotating ceramic into place against the stationary carbon.



Press against the spring and force the carbon to its seat in the seal plate.

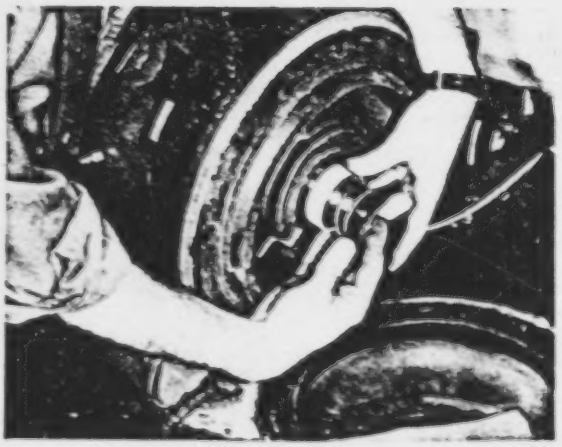
Leaving the spring in place on the motor shaft, reinstall the impeller.



Using the key and keyway as a guide, place the impeller in position and slide it onto the shaft taper. Be sure that the impeller is firmly seated on the motor shaft taper and tighten the impeller bolt. Replace volute gasket (a spare was shipped with the station and will be found behind the control cabinet). Turn assembly upright. Lower the motor impeller assembly into the volute and install the four cap screws.

Reconnect the electrode probe wire and vacuum line.

Open the discharge plug valve.



Return motor circuit breaker to the "ON" position. Turn Selector Switch for the serviced pump to the "AUTO" position. The pump will not prime until sufficient water is in the wet well to call for pump operation. If the pump primes normally, there are no leaks. If it does not prime, check for leaks. When the pump is primed, it should start pumping in normal fashion. Check for seal leaks or other high pressure leaks. Turn alternator switch to alternate.

SMITH & LOVELESS WAFER CHECK VALVE

The Smith & Loveless wafer check valves are especially designed for sewage applications, and are standard equipment on the S&L Wet Well Mounted Lift Station.

The Hi-Tensile cast iron body is clamped between the discharge plug valve and the discharge elbow of each pump. One right hand and one left hand wafer check valve are provided, the only difference being the location of the external arm. (All parts are interchangeable).

Internally, a bronze clapper disc seats against a Buna-N seat, forming a vaccum tight seal when closed. The clapper disc is attached to a bronze arm by a stainless steel roll pin, and the arm is fastened to the stainless steel shaft by another stainless steel roll pin. The shaft is grooved to hold neoprene "O" rings to form a leak proof seal where the shaft passes through the valve body.

The external cast iron arm is secured to the valve shaft by a roll pin. The weight of the external arm plus the spring provides a balanced closing force to make the valve non-slamming. As the pump shuts down, the valve decreases and the weight of the external arm and the spring forces the valve disc toward its seat. At the moment of zero velocity, the disc contacts the seat and slamming is avoided. The external arm may also be used to open the valve manually to backflush the pump. Its position also gives a visual indication whether the pump is actually discharging sewage or not.

MAINTENANCE

Normally, S&L wafer check valves need very little maintenance. However, it is quite easy to remove and disassemble the valve for service.

To remove a S&L wafer check valve, first turn off the electrical power to the pump. Then close the discharge plug valve. Next, loosen the flange bolts which hold the check valve in place and remove the bolts from one side so that the check valve may be slipped out. It may be necessary to force the flanges apart slightly to unseat the gaskets and release the check valve. Remove the old flange gaskets.

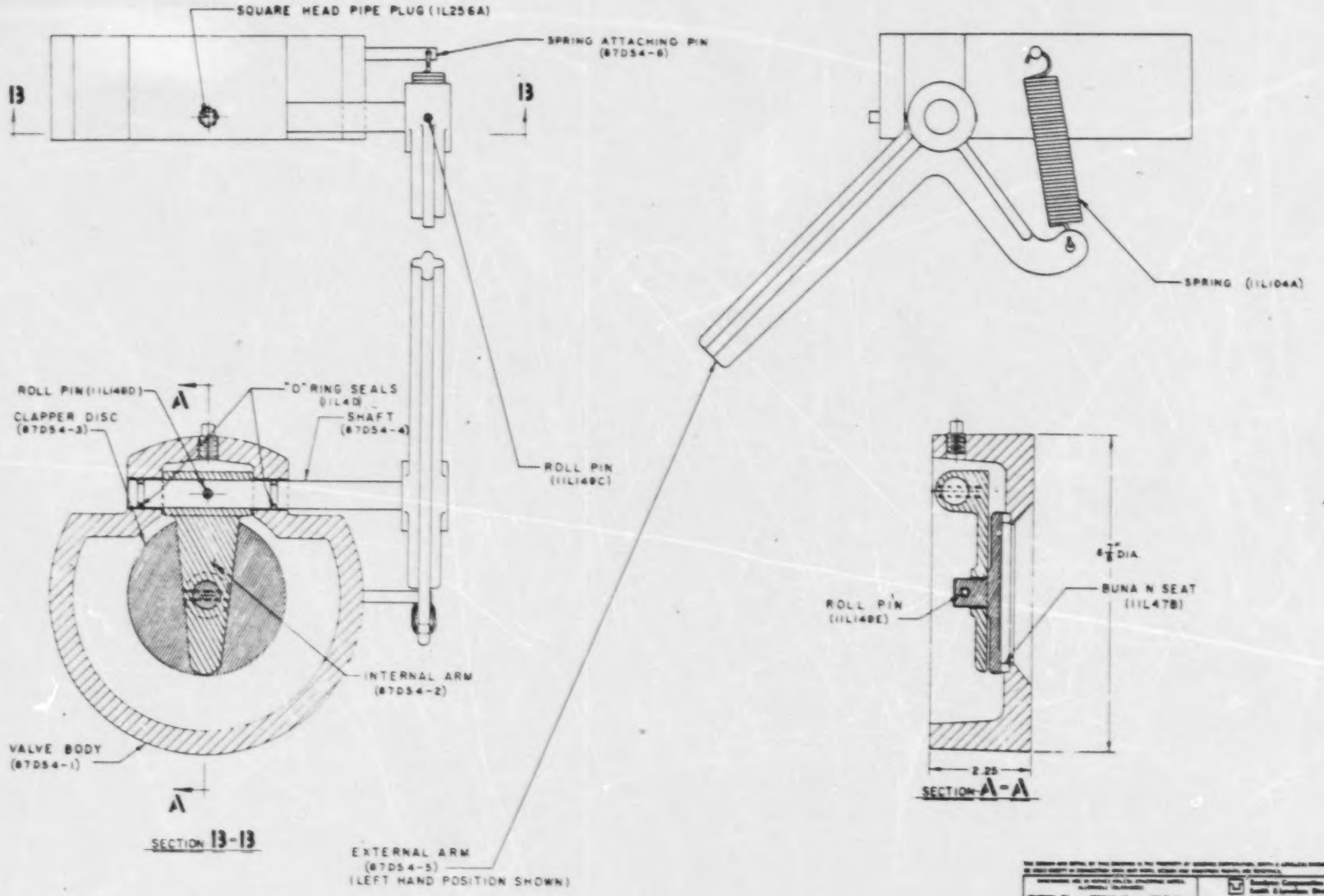
The Buna-N valve seat may be replaced without disassembling the valve. Carefully cut the old seat ring from its groove, removing all traces of Buna-N and adhesive. Clean the groove thoroughly with a solvent such as Ketone. When the surface is clean and dry, bond the new neoprene seat in place using Scotch-Grip Industrial Adhesive #847 as supplied by the 3M Company. Follow the instructions on the label. Be sure to clean off any excess adhesive.

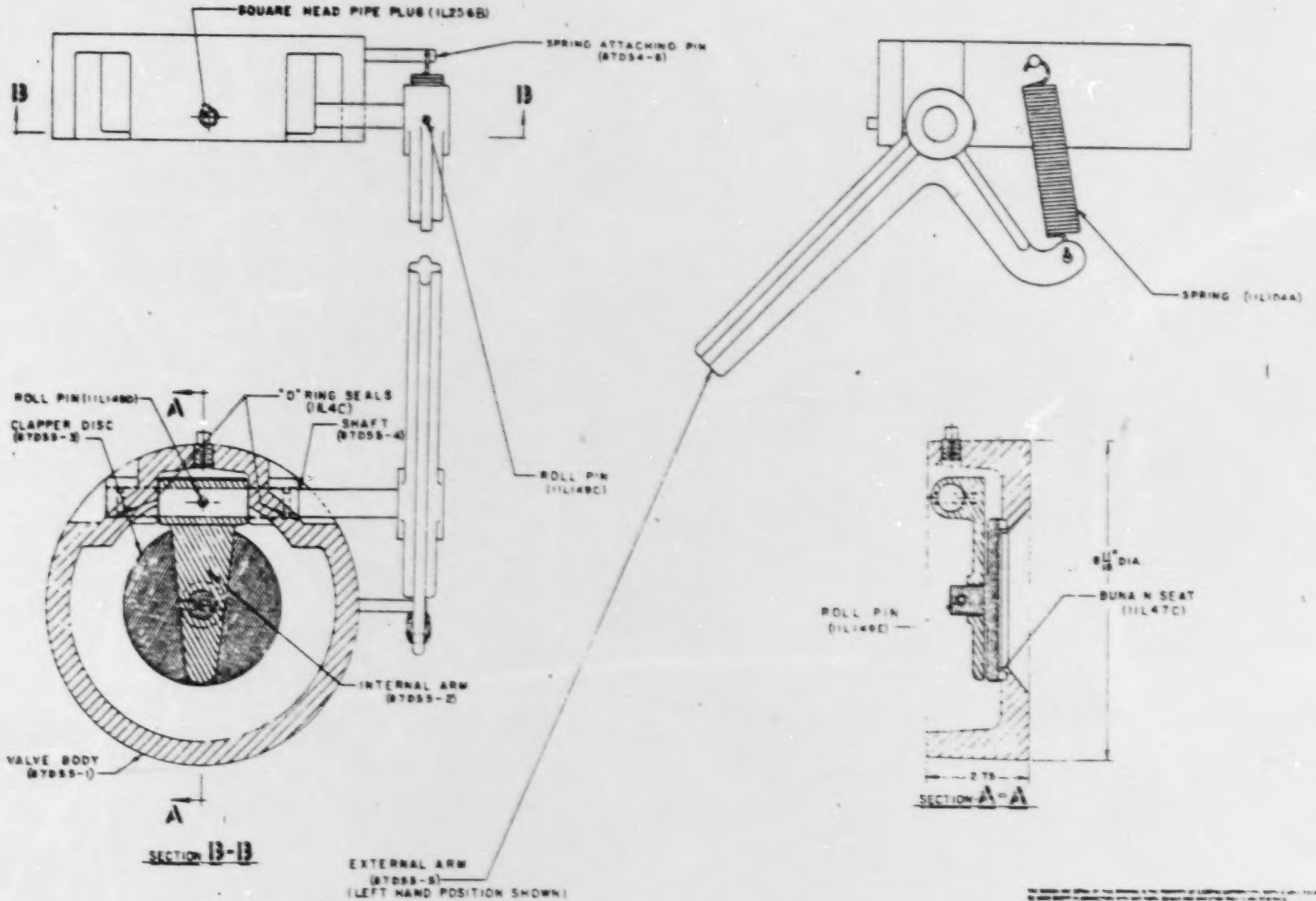
To replace the "O" ring seals, it is necessary to disassemble the valve. Before beginning disassembly, note the position of the external arm with relationship to the internal arm and clapper disc, and match mark the shaft and arms to insure correct reassembly. Remove the square head pipe plug from the top of the valve body. With the clapper in the "Open" position, insert a 3/16" drift pin or punch through the pipe plug opening and drive out the roll pin holding the internal arm to the shaft. It's now possible to remove the shaft from the valve. Clean and inspect all parts of the valve and replace any which show signs of wear or damage.

When reassembling the valve, the following procedure must be followed to avoid damaging the "O" ring seals. (Always use new "O" rings). First, coat the shaft and the shaft bore in the valve housing with a thin film of grease. Next, place an "O" ring in the groove nearest the external handle end of the shaft. Then, holding the internal arm in place, slide the shaft through the housing and internal arm and just far enough out the other side of the housing so that the other "O" ring may be installed. Slide the shaft back into the housing and line up the holes in the internal arm and shaft. Be sure that the match marks line up and the arms are in their proper positions. Replace the roll pin, driving it in flush. Replace the square head pipe plug. Check the operation of the valve to be sure that it operates freely and does not bind.

When installing the check valve in the lift station piping, be sure that the square head pipe plug is at the top and the valve handle points toward the discharge plug valve. Use new flange gaskets on both sides of the valve. Replace and retighten the flange bolts evenly.

Operate the valve manually to see that the external arm clears all obstructions. Then open the discharge plug valve and turn the electrical power to the pump back on.


SQUARE HEAD PIPE PLUG (1L256A)
SPRING ATTACHING PIN (87D54-6)
13
13
SPRING (1L104A)
ROLL PIN (1L148D)
A
"O" RING SEALS (1L40)
CLAPPER DISC (87D54-3)
SHAFT (87D54-4)
ROLL PIN (1L148C)
INTERNAL ARM (87D54-2)
VALVE BODY (87D54-1)
A
SECTION 13-13
EXTERNAL ARM (87D54-5) (LEFT HAND POSITION SHOWN)
4 7/8" DIA
BUNA N SEAT (1L47B)
ROLL PIN (1L148E)
2.25
SECTION A-A
MDH
3" WAFER CHECK VALVE
88D108


SQUARE HEAD PIPE PLUG (1L256B)
SPRING ATTACHING PIN (8TD54-8)
B
B
ROLL PIN (11L49C)
ROLL PIN (11L49C)
"O" RING SEALS (1L4C)
SHAFT (8TD58-4)
CLAPPER DISC (8TD59-3)
A
INTERNAL ARM (8TD55-2)
VALVE BODY (8TD55-1)
A
SECTION B-B
EXTERNAL ARM (8TD58-5)
(LEFT HAND POSITION SHOWN)
SPRING (11L104A)
ROLL PIN (11L49C)
BUNA N SEAT (11L47C)
SECTION A-A
NONE
8" WAFER CHECK VALVE

GAST MANUFACTURING CORPORATION

P. O. BOX 97, BENTON HARBOR, MICHIGAN 49022

PHONE 616 926 6171

70-2000

8-1-70

PARTS LIST AND OPERATING AND MAINTENANCE INSTRUCTIONS FOR MODELS

1VAF VACUUM
1HAB 100 PSI
1LAA 50 PSI

OIL-LESS RECIPROCATING VACUUM PUMPS and AIR COMPRESSORS

OPERATING AND MAINTENANCE INSTRUCTIONS FOR OIL-LESS PISTON COMPRESSORS AND VACUUM PUMPS

CAUTION: Never lubricate this dry oil-less piston pump. The Teflon® filled rings are self-lubrication and require no oil. The motor bearings are grease sealed for the life of the bearing.

GUARANTEE: Gast products are guaranteed against defects in material or workmanship (normal wear of parts excluded) for a period of one year from date of shipment from factory or 2500 hours of operation, whichever occurs first. Units failing within warranty will be rebuilt or replaced at Gast's discretion, F.O.B. factory. When ordering spare parts, give model and serial number.

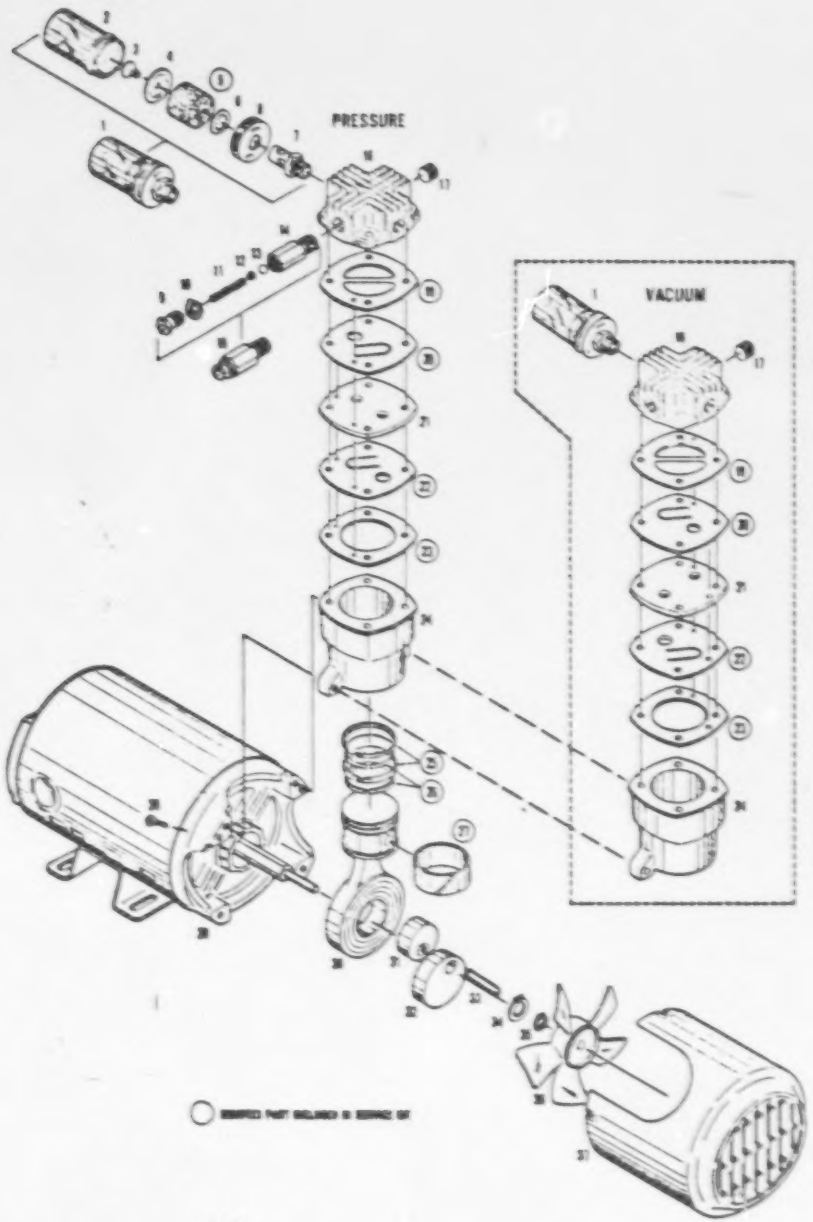
CLEANING: This unit requires NO flushing. Dust off filter felts as they become dirty. To replace felts, remove the plastic jar. The felt is held in place by an end cap, and a steel stud which can readily be pulled out. To clean the internal parts, remove the shroud and remove the cylinder head. No other maintenance is required.

DIS-ASSEMBLY: It is not necessary to remove the filters from the cylinder head as metal chips could be dislodged and enter the unit. Remove the shroud, cylinder head, and valve components. Do not re-arrange the valve components. Remove the cylinder and rings. Make sure all parts are clean before re-assembling. DO NOT use any chlorinated solvents to clean valves, or any liquids to flush units. THE STAINLESS STEEL VALVES MAY BE CLEANED WITH WATER. All parts, except the valves, can be cleaned with any industrial, non flammable, non toxic, cleaning solvent.

ELECTRICAL: Remove the plate covering the electrical terminal for wiring instructions.

ASSEMBLY: Install piston seals, piston rings, and ruler rings on the piston. Locate ring joints approximately opposite each other. Attach cylinders to bracket with the cylinder screws and lock washers. Tighten screws finger tight. Move pistons to top dead center position. Adjust each cylinder flush with top of piston and torque cylinder screws to 85-90 lb. in. Re-torque second time. The valve leaf is pre-bent and should not be adjusted in any way. Stack the valve components in order as shown in detail. Use lock washers on all head screws. Install one valve head assembly to a cylinder. Do not tighten head screws at this time. Watch head timing marks * *(On the top of the cylinder head, the end of two fins have been omitted.) They are always in the exhaust port. Install manifold nuts and seals on the manifold and assemble into the elbow fitting, but do not tighten. Install second valve-head assembly on the other cylinder and manifold. Torque all head screws to 85-90 lb. in. Re-torque again. Position manifold and tighten manifold nut 1/2 to 3/4 turns beyond hand tight.

INSPECTION: Regular inspection may prevent expensive repairs. Do not be alarmed if pump temperature reaches 150-350° F. when running continuously. If pump or motor shows evidence of overheating or excessive noise, stop immediately for repairs. It is quickest and cheapest to remove pump from base and return it to the factory for guaranteed rebuilding. All returns are F.O.B. Benton Harbor, Michigan, Carlstadt, New Jersey, or Paramount, California.



REF NO	PART NO.	DESCRIPTION	QUANTITY REQUIRED 1HAB	1LAA	1VAF
1	B300A	INLET FILTER	1	1	1
2	B306	JAR	1	1	1
3	B378	RIVET STUD	1	1	1
4	AA730	END CAP	1	1	1
5	B344A	FELT	1	1	1
6	B307	RETAINING RING	1	1	1
7	B303	BODY	1	1	1
8	B305	CAP	1	1	1
15	AF570A	SAFETY VALVE	1	1	
9	AA314	ADJUSTMENT SCREW	1	1	
10	AA96	LOCK NUT	1	1	
11	AF609	SPRING	1	1	
12	AF578	SPRING BUTTON	1	1	
13	AF572	BALL	1	1	
14	AF608	BODY	1	1	
16	AF508	CYLINDER HEAD	1	1	1
17	BA603	PIPE PLUG	1	1	2
19	AF518	HEAD GASKET	1	1	1
20	AF531	VALVE, OUTLET	1	1	1
21	AF529	VALVE PLATE	1	1	1
22	AF530	VALVE, INLET	1	1	1
23	AF519	CYLINDER GASKET	1	1	1
24	AF510	CYLINDER	1	1	1
25	AF527	PISTON RING	2	2	2
26	AF526	PISTON SEAL	2	2	2
27	AF584	RIDER RING	1		
27	AF526	RIDER RING		1	1
28	AF501A	BRACKET		1	
29	AF501B	BRACKET	1		
29	AF501F	BRACKET			1
30	AF560	PISTON ROD ASSEMBLY	1	1	1
31	AF513A	ECCENTRIC		1	
31	AF513B	ECCENTRIC	1		
31	AF513F	ECCENTRIC			1
32	AF517A	COUNTERWEIGHT		1	
32	AF517B	COUNTERWEIGHT	1		
32	AF517D	COUNTERWEIGHT			1
33	AF624	FLAT KEY	1	1	1
34	AF625	GRIP RING	1	1	1
35	AF574	RETAINING RING	1	1	1
36	AF633	FAN	1	1	1
38	AF634	SHROUD	1	1	1

To rebuild model 1HAB order service kit number K284
To rebuild model 1LAA or 1VAF, order service kit number K288

GAST MANUFACTURING CORPORATION

P. O. BOX 97, BENTON HARBOR, MICHIGAN 49022

PHONE 616/926-6171

70.2300

(1-4-71)

PARTS LIST AND OPERATING AND MAINTENANCE INSTRUCTIONS FOR MODELS

4VCF

4VSF STAGED

OIL-LESS RECIPROCATING VACUUM PUMPS

PRINTED IN U.S.A.

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OPERATING AND MAINTENANCE INSTRUCTIONS FOR OIL-LESS PISTON COMPRESSORS AND VACUUM PUMPS

CAUTION: Never lubricate this dry oil-less piston pump. The Teflon® filled rings are self-lubricating and require no oil. The motor bearings are grease packed for the life of the bearing.

GUARANTEE: Gast products are guaranteed against defects in material or workmanship (normal wear of parts excluded) for a period of one year from date of shipment from factory. Units failing within warranty will be rebuilt or replaced at Gast's discretion, F.O.B. factory.

CLEANING: This unit requires NO flushing. Dust off filter felts as they become dirty. To replace felts, remove the plastic jar. The felt is held in place by an end cap, and a rivet stud which can readily be pulled out.

DIS-ASSEMBLY: It is not necessary to remove the filters from the cylinder head as metal chips could be dislodged and enter the unit. Remove the shroud, cylinder head, and valve components. Do not re-arrange the valve components. Remove the cylinder and rings. Make sure all parts are clean before re-assembling. DO NOT use any chlorinated solvents to clean valves, or any liquids to flush units. THE STAINLESS STEEL VALVES MAY BE CLEANED WITH WATER. All parts, except the valves, can be cleaned with any industrial, non flammable, non toxic, cleaning solvent.

ELECTRICAL: Remove the plate covering the electrical terminal for wiring instructions.

ASSEMBLY: Install piston seals, piston rings, and rider rings on the piston. Locate ring joints approximately opposite each other. Attach cylinders to bracket with the cylinder screws and lock washers. Tighten screws finger tight. Move pistons to top dead center position. Adjust each cylinder flush with top of piston and torque cylinder screws to 85-90 lb. in. Re-torque second time. Stack the valve components in order as shown in the detail. The valve leaf is pre-bent and should not be adjusted in any way. Install the cylinder head, lock washers, and head screws. The exhaust ports in the cylinder head have been marked by omitting the ends of two of the fins. Do not tighten head screws at this time. Install manifold nuts and seals on the manifold and assemble into the elbow fitting, but do not tighten. Install second valve-head assembly on the other cylinder and manifold. Torque all head screws to 85-90 lb. in. Re-torque again. Position manifold and tighten manifold nut ½ to ⅝ turns beyond hand tight.

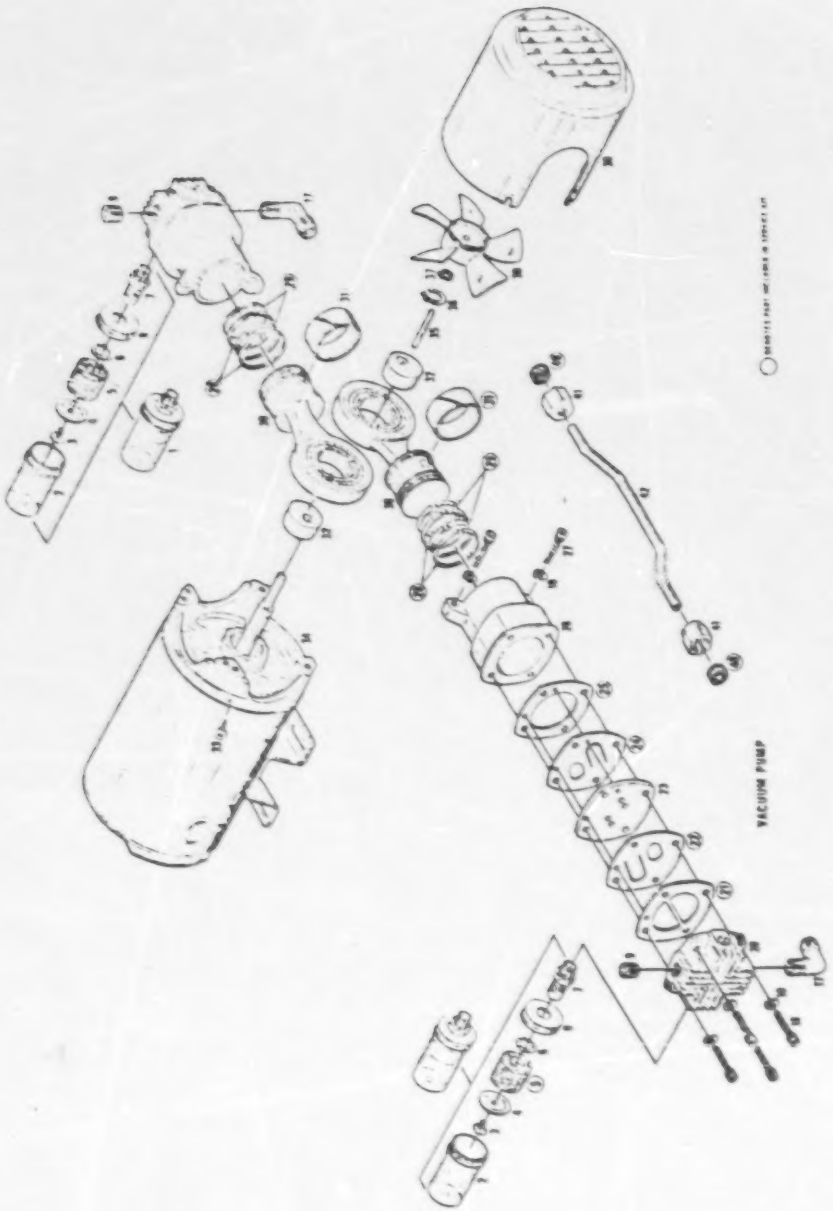
INSPECTION: Regular inspection may prevent expensive repairs. Do not be alarmed if pump temperature reaches 150-250° F. when running continuously. If pump or motor shows evidence of overheating or excessive noise, stop immediately for repairs.

It is usually quickest and cheapest to send the motor in for repair. Authorized service facilities are located at:

Brenner-Fiedler and Associates
16210 Gundry Avenue
Paramount, CA 90723
213/636-3206

Gast Manufacturing Corporation
515 Washington Avenue
Carlstadt, NJ 07072
201/933-8484

Gast Manufacturing Corporation
2300 M-139
Benton Harbor, MI 49022
616/926-6171

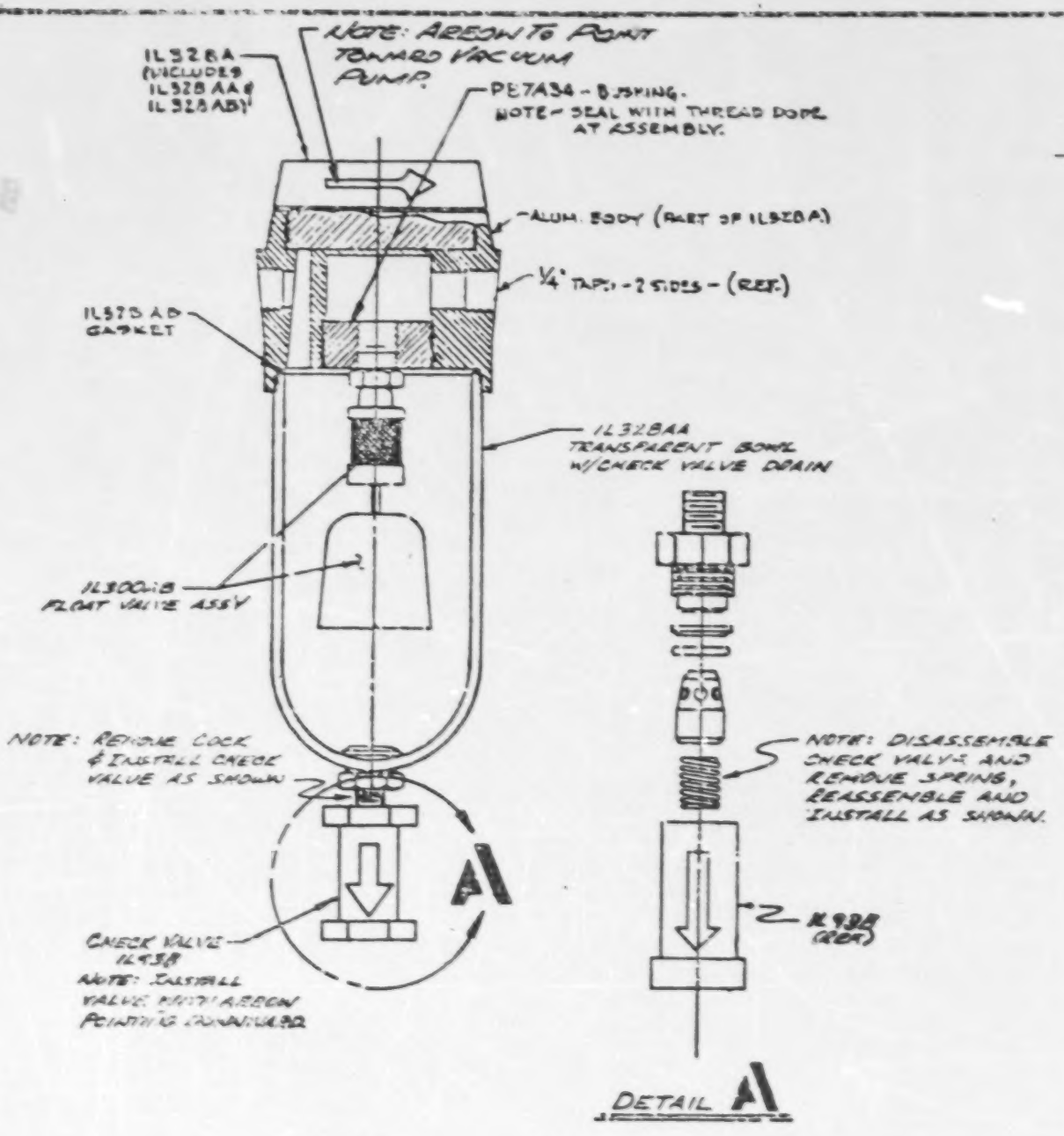


VACUUM PUMP

REF NO.	PART NO.	DESCRIPTION	QUANTITY REQUIRED	
1	B300A	INLET FILTER	2	1
2	B306	JAR	2	1
3	B378	RIVET STUD	2	1
4	AA730	END CAP	2	1
5	B744A	FELT	2	1
6	B307	RETAINING RING	2	1
7	B303	BODY	2	1
8	B305	CAP	2	1
9	BA503	PIPE PLUG	3	2
17	AF537	ELBOW FITTING	2	2
18	BB618	HEAD SCREW	8	8
19	BC115	LOCKWASHER	12	12
20	AF507	CYLINDER HEAD	2	2
21	AF520	HEAD GASKET	2	2
22	AF545	VALVE, OUTLET	2	2
23	AF543	VALVE PLATE	2	2
24	AF544	VALVE, INLET	2	2
25	AF521	CYLINDER GASKET	2	2
26	AF506	CYLINDER	2	2
27	BB618	CYLINDER SCREW	8	8
28	AF541	PISTON RING	4	4
29	AF540	PISTON SEAL	4	4
30	AF561	PISTON ROD ASSEMBLY	2	2
31	AF542	RIDER RING	2	2
32	AF516F	ECCENTRIC	2	2
33	BB411	SCREW	4	4
34	AF500F	BRACKET	1	1
35	AB136D	SQUARE KEY	1	1
37	AC446	RETAINING RING	1	1
38	AF547	FAN	1	1
39	AF549	SHROUD	1	1
40	AF567	MANIFOLD SLEEVE	2	2
41	AF565	MANIFOLD NUT	2	2
42	AF550E	MANIFOLD	1	1

On the staged model, 4VSF, items 20 thru 25 are rotated 90° clockwise on the RIGHT SIDE ONLY
To rebuild, order service kit K262.

When corresponding or ordering spare parts, please give complete model and/or serial number.


NOTE: AREOW TO POINT TOWARD VACUUM PUMP.
IL328A (INCLUDES IL328AA & IL328AB)
PE7A34 - BUSHING. NOTE - SEAL WITH THREAD DOPE AT ASSEMBLY.
ALUM. BODY (PART OF IL328A)
1/4" TAPS - 2 SIDES - (REF.)
IL373AD GASKET
IL328AA TRANSPARENT BOWL W/CHECK VALVE DRAIN
IL300-18 FLOAT VALVE ASS'Y
NOTE: REMOVE COCK & INSTALL CHECK VALVE AS SHOWN
NOTE: DISASSEMBLE CHECK VALVE AND REMOVE SPRING, REASSEMBLE AND INSTALL AS SHOWN.
K93A (REF.)
CHECK VALVE IL43A
NOTE: INSTALL VALVE WITH ARROW POINTING DOWNWARD
A
DETAIL A

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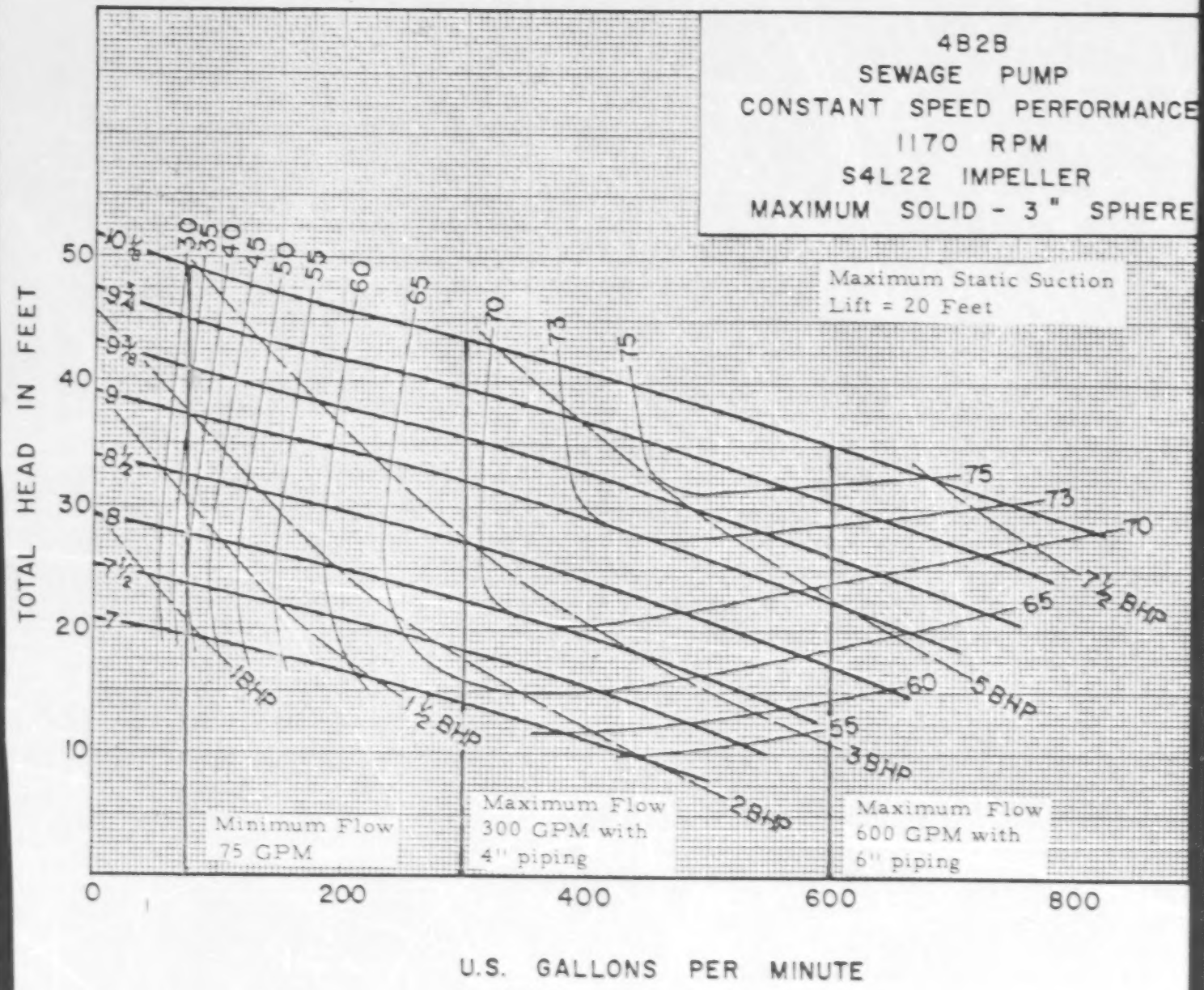
UNLESS OTHERWISE STATED TOLERANCES	DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED	Ecodyna Corporation Smith & Loveless Division An Affiliate of Trane Union Corporation 9385 & Old Santa Fe Trail Lenexa, Kansas 66216
FRACTIONS ~ DECIMALS ~ ANGLES ~	DRAWN BY: MACEK — DATE 8-21 70	FOR:
	CHKD. BY: — DATE	FLOAT CHECK VALVE ASS'Y
	APPVD. BY: — DATE	

REV. LT.	REV. NO.	DATE	BY CHK'D.
C	N71-13	2/71	
B	N70-123	12/70	
A	N70-70	8-21 70	

SCALE NONE — SER. NO. — DRWG. NO. 37A76


4B2B
SEWAGE PUMP
CONSTANT SPEED PERFORMANCE
1170 RPM
S4L22 IMPELLER
MAXIMUM SOLID - 3" SPHERE
Maximum Static Suction Lift = 20 Feet
TOTAL HEAD IN FEET
U.S. GALLONS PER MINUTE
Minimum Flow 75 GPM
Maximum Flow 300 GPM with 4" piping
Maximum Flow 600 GPM with 6" piping
1 BHP
1½ BHP
2 BHP
3 BHP
5 BHP
7½ BHP

Module No:	Module Title: Preventive Maintenance
	Submodule Title:
Approx. Time: 1 hour	EVALUATION

Objectives:

The learner will compile 30 out of a possible 35 point quiz. Quiz will consist of (a) one 10 point practicle problem where he will demonstrate accuracy and completeness in the physical use of a PM tool applied to an actual operating piece of water or wastewater process equipment; (b) 5 true - false questions; (c) 10 multiple choice questions;(d) 10 matching all concerning PM on water and wastewater equipment.

Practical portion of test will be given in a place separate from the written portion of the exam so that those working on the written exam will not be bothered by the practical. Learners will complete the practical after they have completed the written exam.

Preventive Maintenance Quiz

A. True - False (1 - 5) Circle "T" if treu and "F" if false.

1. T F PM is a way of protecting a valuable investment.

2. T F A plant log is strictly a confidential record to be kept within the operation personnel of a water or wastewater treatment plant.

3. T F A good inventory is necessary in a PM program so that the operator can tell at any time what replacement parts he has on hand.

4. T F Equipment cards are to be filed where they are easily accessible by all maintenance personnel.

5. T F A good PM record will keep the operator updated on what maintenance he has performed, but is of no value in indicating arising problems.

B. Multiple Choice. Circle the letter of the best choice(s) of the answers given. There may be more than one answer.

1. The purpose of an O & M manual is to:

a. Confuse the operator by giving him more information than he needs.

b. Give the operator the technical information needed to operate and maintain his equipment.

c. List parts numbers and descriptions for replacement.

d. Keep a record of operation and maintenance done on equipment.

2. The O & M manual usually includes information on:

   a. Installation, start-up, trouble shooting, maintenance.

   b. Technical data on the equipment.

   c. Manufacturers of pertinent lubrication products.

3. A good trouble shooting guide should be designed so that it can be followed and understood during an equipment breakdown by:

   a. The general public

   b. Only a well trained maintenance man

   c. Any operation or maintenance staff personnel

   d. Only a select few staff members

4. A pump curve shows:

   a. Head in feet

   b. Size of impeller

   c. Rate in GPM

   d. Size of solids the pump will handle

5. An equipment card would contain which of the following information?

   a. When the last maintenance was performed

   b. Frame size

   c. Horsepower

   d. Manufacturers name

6. When is a good time to begin a PM program?

   a. Before a piece of equipment is first started up.

   b. Once the operator gets the "feel" of running a piece of equipment.

   c. After a piece of equipment has been maintained several times.

7. A runout gauge can tell you:

   a. How far a piece of equipment will move when started up.

   b. The speed at which the shaft is running.

   c. The shaft is bent.

   d. The impeller is out of balance.

8. Pressure gauges can help you in determining:

   a. If a pressure sand filter is plugging.

   b. The efficiency of a pump discharge.

   c. The drawdown of a well.

9. A voltage meter can:

   a. Only be used by a certified electrician.

   b. Indicate head loss on a pump discharge.

   c. Indicate fluctuations in electrical power supply.

10. A PM records system should be kept updated:

    a. Once every 6 months

    b. Once a week

    c. Daily

    d. When the operator has nothing better to do.

C. Matching. Match the PM points on the left with the tools listed on the right. Mark the letters from the column on the right in the blanks provided after the numbers on the left.

1._____Packing gland	a. Volt-amp meter
2._____Force main	b. Feeler gauge
3._____Well	c. Runout gauge
4._____Electric motor starter	d. Wrench set
5._____Pump shaft	e. Pressure gauge

6._____Pump impeller	f. Tackometer
7._____Electric motor starter	g. Altitude gauge
8._____Comminutor teeth	h. Ohm meter
9._____Grease fitting	i. Outside calipers
10._____Motor shaft	j. Grease gun

D. Practical

Upon completion of the previous portions of the exam you will proceed to the designated area for the practical exam. Here you will be observed by an instructor on a one to one basis. You will be graded by this instructor in two parts. Part I - Oral (5 points) and Part II - Manual Demonstration (5 points). Please be complete and accurate in both categories as you possibly can.

Module No:	Topic:
Instructor Notes:	Instructor Outline:

Answers to Examination Questions

A. 1. T
2. F
3. T
4. T
5. F

B. 1. b, c
2. a, b, c
3. c
4. a, c
5. b, c, d
6. a
7. c, d
8. a, b
9. c, d
10. c

C. 1. d
2. e
3. g
4. h
5. c
6. i
7. a
8. b

Module No:	Topic:

Instructor Notes:	Instructor Outline:
	9. j 10. c D. Instructor will provide a centrifugal pump with electric motor of any variety. He will also have on hand one of each of the following: Volt-amp meter, standard grease gun, wheel tackometer, shaft runout gauge. The instructor will assign students on a one-to-one basis one of these tools. Grading will be left to the instructors interpretation of how well the learner has described the purpose of the tool as well as his accuracy with it in applying it to the pump.